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VACCINE AGAINST INFECTIOUS AGENTS HAVING AN INTRACELLULAR PHASE, COMPOSITION FOR THE TREATMENT AND PREVENTION OF HIV INFECTIONS, ANTIBODIES AND METHOD OF DIAGNOSIS.

The present invention relates to new types of vaccines and, in particular, to compositions intended for the treatment, prevention and diagnosis of HIV conditions.

More specifically, the present invention relates to peptides capable of producing an immune response capable of directly or indirectly neutralizing HIV viruses in mammals and in particular in man.

The importance of monoclonal antibodies directed against β_2 -microglobulin ($\beta 2m$) in the inhibition of HIV-1 replication has already been described, particularly in patent EP-B-0,470,989 as well as in various publications.

In particular, it has been possible to demonstrate that these antibodies act on two mechanisms, namely directly on the virus and on the cells associated with $\beta 2m$.

The present invention constitutes developments of these preliminary elements and is based on the identification of peptide sequences obtained from $\beta 2m$ or having an equivalent structure which are capable of generating antibodies completely or partially neutralizing the HIV viruses.

Given the complexity of the mechanisms used, "neutralization of the HIV virus" will be understood to mean any mechanism having the effect *in vivo* of destroying and/or of preventing the propagation of viruses.

In vitro, these neutralizing antibodies can be used to neutralize any body fluid intended to be reinoculated or reintroduced into man, such as the sperm of a man seropositive for HIV for the insemination of a seronegative woman.

However, more generally, the present invention is based on a new vaccinal approach which can be used, in particular, for infectious agents of the parasite or virus type with a high mutating power. Indeed, in the context of traditional vaccination, it is sought to

generate neutralizing antibodies directed against components of the infectious agent, but when the latter exhibits a high mutating power, such as HIV for example, this strategy gives, at best, only limited results for a 5 particular isolate which will be very rapidly replaced by a mutant and resistant isolate.

The new vaccinal approach is based on a different concept and is applicable to a number of infectious agents which have an intracellular phase during their 10 cycle.

Indeed, it is known for certain agents, or it is possible to demonstrate, especially in the case of HIV, which constitutes part of the present invention, that, during the multiplication of the infectious agents from 15 the infected cells of the host, the extracellular infectious agents carry away components of determinants of the host cell.

One of the subjects of the present invention consists in taking as target, not the infectious agent 20 itself, but the components of the determinant which it carries away with it and to provide for a vaccination directed against these cellular determinants which will remain constant, even if the agent itself has mutated.

This type of approach has, of course, an immediate limit, the antigen being bound to the host cells, it is only possible to carry out such a vaccination with a cryptic epitope of the cellular determinant which will be exposed only when it is carried away by the extracellular infectious agent, or an epitope which is nonimmunogenic in its natural presentation by the cell and which 30 is modified when it is presented at the surface of the virion.

In the case of HIV for example, it has been possible to demonstrate that β_2 -microglobulin has several 35 cryptic epitopes, which are exposed during the multiplication of the HIV virus and its passage outside the cell. There is not therefore, in the event of vaccination, on the one hand, an autoimmune reaction, and, on the other hand, the epitope being bound to the different HIV

isolates which have been tested, the vaccination is effective, this being independent of the mutations of the virus itself.

5 This type of vaccination can be selected, in particular, for intracellular parasites and enveloped viruses such as CMV, HPV, HSV and HIV for example.

10 It should be clearly understood that while this type of vaccination cannot be used in all cases, it can constitute a very useful alternative for infectious agents which are resistant to more traditional approaches.

15 Accordingly, the present invention relates to a vaccine against an infectious agent, characterized in that it comprises at least one cryptic epitope of a cellular element carried away by an intracellular infectious agent during its passage outside the cell and which is exposed by the infectious agent.

20 Preferably, this infectious agent is a parasite or an envelope virus and the cryptic epitope is situated near the surface of the cell.

25 "Cryptic epitope" is intended to designate an epitope of a cellular determinant of the host which is hidden or modified and is therefore recognized as being foreign by the immune system and does not therefore produce an autoimmune reaction with destruction of the corresponding determinant and which can be used for vaccination.

30 The cryptic epitope should obviously be exposed, that is to say be accessible and recognized by the immune system when it is carried away by the infectious agent (in the event that it should remain cryptic, the vaccination would not be possible).

35 In the case of β_2 -microglobulin, it has been possible to demonstrate the existence of this type of epitope which is in fact also found in a natural form during the elimination of β_2 -microglobulin by the urinary tract.

The present invention therefore relates to compositions intended for the treatment or prevention of

HIV infections, characterized in that they comprise, as active ingredient, at least one peptide corresponding to sequences 1 to 22 or an equivalent sequence. "Equivalent sequence" is intended to designate a sequence which lifts 5 the neutralization of the HIV virus by the monoclonal antibodies B1G6 or B2G2.2 in vitro.

These peptides constitute cryptic epitopes of β_2 -microglobulin as described above.

The peptides according to the present invention 10 are the following:

01-P1 IQRTPKIQVYSRHPA

(Ile-Gln-Arg-Thr-Pro-Lys-Ile-Gln-Val-Tyr-Ser-Arg-His-Pro-Ala)

02-P4 FHPSDIEVDLLKDGE

15 (Phe-His-Pro-Ser-Asp-Ile-Glu-Val-Asp-Leu-Leu-Lys-Asp-Gly-Glu)

03-P9 ACRVNHVTLSQPKIV

(Ala-Cys-Arg-Val-Asn-His-Val-Thr-Leu-Ser-Gln-Pro-Lys-Ile-Val)

20 It is also possible to use a smaller part (7 amino acids) of these 15 amino acids which lifts the neutralization of the virus by the monoclonal antibodies B1G6 or B2G2.2:

04-R-7-V RTPKIQV (Arg-Thr-Pro-Lys-Ile-Gln-Val)

25 05-S-7-K SQPKIVK (Ser-Gln-Pro-Lys-Ile-Val-Lys)

06-F-7-E FHPSDIE (Phe-His-Pro-Ser-Asp-Ile-Glu)

A common structure PKI (3 amino acids) appears to be the unit which is responsible; hence the following amino acid modifications:

30 07-TLSRTPKIQV (Thr-Leu-Ser-Arg-Thr-Pro-Lys-Ile-Gln-Val)

No. 185

08-IYLTPQPKIKV (Ile-Tyr-Leu-Thr-Gln-Pro-Lys-Ile-Lys-Val)

No. 186

09-IQRTPKIQVY (Ile-Gln-Arg-Thr-Pro-Lys-Ile-Gln-Val-Tyr)

35 No. 187

10-TLSQPKIVKN (Thr-Leu-Ser-Gln-Pro-Lys-Ile-Val-Lys-Asn)

No. 188

11-IQRTPKIVKW (Ile-Gln-Arg-Thr-Pro-Gln-Ile-Val-Lys-Trp)

No. 189

12-IQRTPNIVKW (Ile-Gln-Arg-Thr-Pro-Asn-Ile-Val-Lys-Trp)
No. 190

It is also possible to introduce a cysteine and a glycosylation site:

- 5 13-CYNPSDIE (Cys-Tyr-Asn-Pro-Ser-Asp-Ile-Glu)
14-YCNPEST (Tyr-Cys-Asn-Pro-Glu-Ser-Thr)
15-NFLNCYVS (Asn-Phe-Leu-Asn-Cys-Tyr-Val-Ser)
16-LNCYVSPSD (Leu-Asn-Cys-Tyr-Val-Ser-Pro-Ser-Asp)

Finally, it is possible to use the peptides using
10 the different variations according to the species (mice,
primates, rabbits, guinea pigs):

- 17-KTPQIQV (Lys-Thr-Pro-Gln-Ile-Gln-Val)
18-FHPPQIE (Phe-His-Pro-Pro-Gln-Ile-Glu)
19-FHPPHIE (Phe-His-Pro-Pro-His-Ile-Glu)
15 20-AEPKTVY (Ala-Glu-Pro-Lys-Thr-Val-Tyr)
21-SQPKTVY (Ser-Gln-Pro-Lys-Thr-Val-Tyr)
22-ILSRTPKIQV (Ile-Leu-Ser-Arg-Thr-Pro-Lys-Ile-Gln-Val)

These peptides of SEQ ID 1 to 22 contain only the
preferential choice; it is possible, as has been
20 indicated above, to find equivalent peptides.

Example 5 describes a method which makes it
possible to identify the equivalent peptides.

These peptides are preferably bound to a carrier
system; this may be either one or more protein fragments
25 linked to the N- and/or C-terminal ends of said peptides
in order to allow, in particular, an immune response;
they will then be referred to as "conjugated proteins".
Among the proteins which can be used, there may be
mentioned in particular albumins, KLH (Keyhole Limpet
30 Hemocyanin) MAP (Multiple Antigenic Peptide) or other
proteins known for their immunogenicity. It is also
possible to envisage proteins or protein fragments linked
through nonpeptide bonds such as a disulfide bridge or
bonds through a calcium ion.

35 During the study of the various peptides accord-
ing to the invention, it emerged, although this is only
a theory which cannot limit the present invention in any
manner, that the PKI structure plays an essential role.
Indeed, proline is an amino acid which imposes a confor-

mation and which limits the possibility of a quaternary peptide configuration. Under these conditions, KI (Lys, Ile) is attached in a position which is exposed to reacting with an antibody.

5 Under these conditions, during the construction of the carrier proteins, it is advisable to provide preferably for a structure which leaves the PKI structure accessible.

10 Analysis of the structure of the regions selected for P1, P9 and P10 can be carried out by methods such as the selection using alanine to replace each amino acid separately, particularly in the RTPKIQV region, in order to determine the possible amino acids. It is also possible to use techniques using biotinylation of each 15 peptide, followed by selection by EIA with the antibodies in order to determine the loss of attachment.

20 It is thus possible to envisage conjugating the epitopes in question with nonprotein components, for example polysaccharides and/or lipids, in order to constitute lipoproteins having enhanced vaccinating activities; here again, it is possible to envisage covalent bonds or otherwise.

25 These various types of compounds can be obtained either by chemical synthesis or by recombinant routes using techniques known in the field of production of recombinant proteins.

30 The flexibility of recombinant technologies makes it possible to produce proteins having a plurality of identical or different epitopes and capable of enhancing the activity of the final product. It is also possible to envisage the co-expression of various components entering into the compositions according to the invention.

35 According to one of the aspects of the invention, it will be possible for the peptide to be introduced into a known structural protein of HIV; in particular, constructs in which the peptide of interest is inserted into the hypervariable region of the V3 loop of gp120 can be used.

The V3 region of gp120 is the principal HIV-1

neutralization domain and one of the major determinants of viral tropism. Consequently, this type of mutant can be useful for studying the neutralization of HIV-1 linked to R7V and the modifications of its host spectrum. The 5 high variability of the V3 region of gp120 among the isolates of HIV-1 is another reason for the preference for this region. It has been assumed that the replacement of the sequence of seven amino acids in the V3 region had greater chances of leading to a viable recombinant than 10 a mutation in another, more conservative, region of the HIV-1 genome. The recombinant protein gp120/R7V can be expressed in parallel in a suitable system for expression of a protein in order to obtain a large quantity of immunogen R7V.

15 The use of carrier proteins is not essential; it is possible to provide optionally for other carrier systems. "Carrier system" is intended to designate any component which makes it possible to lead to a unit generating an immune response against the peptide in 20 question, or which makes it possible to protect the peptide from elimination, particularly from a rapid proteolysis.

25 The compositions according to the invention may also comprise components which increase the immuno-
genicity of the peptides and/or proteins, particularly immunity adjuvants, specific or otherwise, such as Freund's adjuvant, polysaccharides or equivalent com-
pounds.

These are methods which are known in the vaccination 30 field.

The compositions according to the invention can be used in any form compatible with the route of administration chosen, in particular the injectable route. However, it will be possible for the compositions accord- 35 ing to the present invention to be used by other routes, particularly per os or by the aerosol route, to induce protection of the mucous membranes.

The present invention also relates to compositions intended to be administered in order to express in

situ the peptides and/or proteins described above.

In particular, the present invention relates to DNA expression cassettes which make it possible to express at least one cryptic epitope as defined above, 5 and in particular the peptide having sequence 1 to 22 and/or the proteins having these peptides or proteins capable of coupling with the peptide in question as defined above or having equivalent sequences.

"Equivalent sequence" is intended to designate a 10 sequence encoding an equivalent peptide as has been described above.

These DNA expression cassettes can, of course, be used either directly for expression in situ, or can be used to produce a peptide or protein which can be used as 15 has been described above.

Vaccination systems using DNA sequences are known and are already widely described in the literature.

They are essentially systems allowing the expression of the antigenic protein in man, or the expression 20 of the antigenic protein in a cell, which is then used for the vaccination; when the transformed cell is a host cell treated outside, the treatment is said to be ex vivo.

The expression systems may be highly varied; they 25 may be in particular "naked DNA" type systems as are described in particular in the patents and patent applications of the company VICAL, WO 90/11092. In this case, the DNA encoding the peptide or protein comprising the peptide is injected as it is; this injection leads, in a 30 number of cases, to the expression of the encoded protein.

The information contained in these documents is explicitly included in the present description by reference.

It will also be possible to use "naked DNA" 35 systems, but comprising their own expression system, particularly in order to enhance the expression.

It will also be possible to use systems promoting the expression, either by integration, or by autonomous

replication, particularly of systems of the plasmid or viral type.

Among the systems for expression of a peptide sequence which may be mentioned, there should be mentioned the systems using poxviruses, adenoviruses, retroviruses and herpes-type viruses or other more recent systems such as polioviruses.

Among the vectors, vectors generating a humoral response and for the mucous membranes will preferably be used.

Other viruses can be used in order to obtain vaccines in particular:

- the adenoviruses as is described in N.R. Rabinovich et al., *Science*, 1994, 265, 1401-1404 and references cited;
- the rotaviruses as is described by Sue E. Crawford, in *Journal of Virology*, Sept. 1994, p. 5945-5952;
- the poxviruses, particularly the vaccinia virus, also animal poxviruses such as the canari pox as is described in the work by Paoletti and Moss;
- influenza virus as described in N.R. Rabinovich et al. (1994).

The technology which makes it possible to use the polioviruses as vaccination vector for various antigens is described particularly in Raul Andino et al., *Science*, 265, 1448-51.

This type of construct, which can be used in the context of the present invention, makes it possible to obtain vaccines which can be used by the oral route; to do this, the sequence encoding the peptide(s), optionally the carrier proteins, is cloned into a poliovirus, for example the attenuated Sabin virus; it is also possible to use a cocktail of viruses encoding various epitopes.

The use of plasmids or of viruses for the expression of proteins in the cells of a host, particularly a human host, is known and will not be explained in detail. The specific constructs obviously depend on the host, the epitope and the vector selected.

It is also possible to use cellular vaccines,

that is to say, for example as is proposed in the context of gene therapy, to collect cells from the patient, to transform them with vectors as described above and then to reimplant them in order to express the proteins in situ.

However, in the case of a vaccination, this method is not very convenient. It will be preferable to use cells which can be obtained in a large number, bacterial or yeast cells for example, which express the protein in question, for example at the surface, which, in some cases, increases the immunogenicity of the protein.

It is possible, for example, to use vaccines comprising, as expression system, *Salmonella* as is described in T.R. Fouts et al., Vaccine (1995) 13 in press; Tacket C.O. et al., Infect. Immun. (1992) 60, 536-541 and Hone et al., J. Chim. Invest. (1992) 90, 412-420 (for its evaluation in man as vaccinal support).

This type of vaccine involves the use of cells, particularly bacterial cells, producing the peptides according to the invention or certain strains of other vaccination vectors and described in Chad P Muller, Immunology Today. vol. 15 No. 20. 1994, p. 458-459.

The cells producing the peptides or proteins according to the invention can be used as they are, in particular when the proteins are expressed at the surface of the cells and when the cells are nontoxic and non-pathogenic (attenuated or killed strain), but can also be used to produce the peptides and/or proteins which will be used after purification.

Thus, it may be advantageous to obtain bacterial cells, but also yeasts or higher cells, animal, plant or insect cells in particular.

In the case of the present invention, it is possible to provide for the use of vaccines of plant origin using the technologies described particularly in C.J. Arntzel et al. in Vaccine 94.

The technologies allowing the expression of the peptides or proteins by cellular systems are known, as

well as the purification techniques.

As has already been mentioned, it is possible to use the compositions according to the invention with adjuvants enhancing the activity of the DNA sequences, 5 particularly components constituting complexes with the DNA, such as cationic lipids or structures of the liposome or microparticle type.

The invention also relates to compositions containing antibodies against the peptides according to 10 the invention or compositions containing sequences encoding antibodies directed against the peptides according to the invention.

Of course, the use of compositions based on antibodies requires that the latter are compatible with 15 administration to a human being; they may be in particular antibodies humanized by known techniques or directly expressed in situ from the DNA sequence.

The present invention also relates to the use of the antibodies raised against the peptides of the invention 20 and capable of neutralizing the HIV virus, in particular the present invention relates to anti-sera comprising this type of antibody or the antibodies obtained, for example by immunopurification, from the said sera.

25 The present invention also relates to a method of diagnosis, characterized in that the presence of an antibody directed against one of the epitopes according to the invention is detected in the serum of a patient.

This method can be carried out by any known 30 method for identifying antibodies, particularly the ELISA and RIA methods and all the methods derived therefrom.

All these methods are preferably based on the attachment of the antibodies in question onto the antigenic peptides described above, followed by the 35 visualization of this attachment. This diagnosis is of considerable interest; indeed, examples show that seropositive individuals in the case of HIV who have antibodies according to the invention do not, in a very large number of cases, progress, that is to say that they

do not develop AIDS. In this case, the prognosis is very favorable and it is possible to avoid expensive treatments. This is particularly true in the case of pregnancy where the presence of these antibodies in the mother 5 (HIV +) would seem to lead to noninfection of the newborn.

The production of the compositions according to the present invention can be carried out by techniques which are known, synthesis of protein by the chemical route, synthesis of DNA by the chemical route or multiplication by PCR-type amplification. For the proteins, these can also be obtained by the recombinant route using appropriate syntheses.

15 The examples below will make it possible to demonstrate other characteristics and advantages of the present invention.

In the accompanying figures,

- Figures 1A and 1B represent ELISAs showing the reactivity of the serum of a rabbit immunized with R7V-KLH for various antigens,
- Figure 2 represents the ELISA showing the reactivity of the antiserum of a rabbit immunized with in particular β 2m,
- Figures 3A to 3D represent the ELISA between different antisera and selected peptides,
- Figure 4 represents the ELISA for R7V with different anti- β 2m antibodies,
- Figure 5 represents the ELISA for R7V-BSA and β 2m with anti- β 2m antibodies and rabbit sera,
- 30 - Figures 6 to 13 represent diagrams showing the effect of the sera of different patients on the neutralization of different isolates of the HIV virus on MT4 and PBL.

EXAMPLE 1

35 This example makes it possible to demonstrate the immune response of rabbits against selected peptides coupled to a carrier protein.

The peptide antigen 7AA is coupled to KLH (Key-hole Limpet Hemocyanin) and injected into rabbits in the

presence of complete Freund's adjuvant.

The animals are immunized in the presence of complete Freund's adjuvant at D0, D14, D28, D42 and trial bleedings are carried out before immunization on days 35, 5 49, 56 and 70.

The peptides used are: RV7-KLH, S7K-KLH and F7E-KLH

The peptide R7V (RTPKIQV) was extended by 2 amino acids in order to allow the coupling. The structure used 10 as immunogen is RTPKIQVGY.

The antibodies of the rabbits immunized 618 were measured by ELISA, where the peptide coupled to various carrier proteins was used at the bottom of the well (either coupled to KLH, to BSA (Bovine Serum Albumin) or 15 MAP (Multiple Antigenic Peptide)).

The diagrams represent the results obtained at 2 dilutions d100 and d1000, that is to say a 1/100 and 1/1000 dilution of the sera, or at different times.

The ELISA method is applied in the following 20 manner:

ELISA method

- 1) Attachment of the antigen onto a 96-well plate (Immulon IV-Dynatech)
 - . dilute the antigen in carbonate buffer pH 9.6
 - 25 → (Ag) final = 1 µg/ml
 - . distribute 100 µl/well, that is to say 100 ng/well
 - . incubate 2 h at 37°C or overnight at 4°C (humid atmosphere).
- 2) Washes
 - 30 . 5 washes with a solution of PBS/Tween 20 at 0.05%.
- 3) Saturation of the wells
 - . distribute 300 µl/well of a solution of PBS/horse (or bovine) serum at 10%
 - . incubate 1 h at 37°C (in a humid atmosphere).
- 35 4) Washes (identical to point 2)
- 5) Incubation with specific antisera
 - . dilute the serum (1/50, 1/100, 1/1000) with PBS-10% horse serum
 - . distribute 100 µl/well and incubate 1 h at 37°C

- (in a humid atmosphere).
- 6) Washes (identical to point 2)
- 7) Incubation with the second antibody (sheep Ig's to human Ig's coupled to peroxidase)
- 5 . dilute the second antibody 2/1000 in PBS/horse serum 10%
- . distribute 100 µl/well and incubate 1 h at 37°C (in a humid atmosphere).
- 8) Washes (identical to point 2)
- 10 9) Visualization with OPD
- . dissolve 10 mg OPD in 25 ml of phosphocitrate buffer (0.1 M, pH 5.5)
- . add at the last moment 10 µl H₂O₂
- . distribute 100 µl/well and incubate 30 min in the 15 dark at room temperature (may be read at 405 nm)
- . stop the reaction with 50 µl H₂SO₄ 12.5%.
- 10) Reading at 492 nm.

Figures 1A and 1B show results obtained with the rabbit 618 immunized with R7V-KLH.

20 An anti-R7V reactivity appears clearly as a differential between R7V-BSA and BSA compared with R7V-KLH and KLH where the anti-R7V reactivity is masked by the anti-KLH response of the serum. It should be noted that the anti-R7V reactivity is stronger at D68 than at 25 D132.

The specificity of the reaction is greater if the BSA protein is used.

Figure 2 again shows good recognition of the original protein, B2m.

30 The antisera of immunized rabbits demonstrate a high reactivity with R7V-BSA as well as with the original peptides called P1, P4 and P9 which were used to select R7V, even though the reactivity with P1 is weaker (Figure 3A - 3D).

35 Figure 4 demonstrates that the recognition of R7V by B1G6 and B2G2.2 depends on the dose and that the recognition of C21.48 is not as good; accordingly, the mAbs B1G6 and B2G2.2 will preferably be used to select equivalent peptides.

These results demonstrate that the R7V epitope, coupled to BSA, is capable of generating a good immune response.

EXAMPLE 2

5 **Introduction of R7V into the V3 loop of HIV-1 LAV gp120**
Construction of a recombinant provirus

The objective of this example is to introduce the R7V sequence into the third variable region V3 of the HIV-1 LAV gp120.

10 **Methods**

Chimeric recombinant viruses were constructed by PCR-directed mutagenesis. Two constructs based on the R7V sequence and HIV-1 LAV were obtained, in which seven amino acids of the V3 region of gp120 have been replaced 15 by the R7V sequence. The positions of the mutated sequences are shown in the following table:

HIV-1 LAV (V3)	NNNTRKSIRIQRGPGRFVT	
R7V	RTPKIQV	(1) RPL
R7V	RTPKIQV	(2) PLG

20 The EcoRI₅₂₇₈-XhoI₈₄₀₁ fragment of HIV-1 LAV cloned into the vector Bluescript was used as template for subsequent constructs. In the first stage, the DNA fragments flanked by primers containing the BglII restriction site at one end and the nucleotide sequence encoding R7V at the other end were synthesized for the RPL and PLG constructs by PCR amplification. The mutagenesis oligonucleotides used consisted of a (+) primer ACACCAAAGATACAAGTTGTTACAAATAGGAAAA and a (-) primer TTGTATCTTGGTGTCTGGATCCGGATACTT for the RPL construct 25 and of a (+) primer CGTACACCAAAAATCCAGGTCCAGAGAGGACCA and a (-) primer GATTTTGTTGTAACCGGTATTGTTGGGTCT for the PLG construct. In the second stage, two PCR products for each construct were mixed and amplified using the primers containing the BglII restriction sites. The RPL and PLG 30 fragments were cleaved by the enzyme BglII and inserted into the vector Bluescript containing the EcoRI₅₂₇₈-XhoI₈₄₀₁.
35

fragment of HIV-1 LAV, cleaved by BglII. In addition to the R7V sequence, the amplification primers contained modifications in the nucleotide sequence leading to the appearance of new BamHI and MluI restriction sites in the 5 RPL and PLG constructs respectively, without additional modifications in the amino acid sequence. The new restriction sites were used to screen the mutated sequences. Finally, the EcoRI₅₂₇₈-XhoI₈₄₀₁ fragments of HIV-1 LAV containing the RPL and PLG constructs were inserted 10 into the plasmid pNL4-3 by homologous recombination using the EcoRI and XhoI restriction sites. The constructs were checked by restriction enzyme analysis.

Transfection of eukaryotic cells

The plasmid DNA of 200 ml of E. coli TG1 was 15 extracted and purified by the Qiagen midipreparation kit. The semiconfluent cultures of COS cells ($= 4 \times 10^6$) were transfected with 7 μ g of plasmid by the calcium coprecipitation technique. The next day, the monolayers of cells were treated with glycerol and placed in coculture with 20 a CEM cell line or with primary blood lymphocytes activated by PHA (PBL, 10^6 cells/ml) obtained from a healthy donor. The CEM or PBL cells were separated from the COS cells in monolayers two days later and cultured separately.

25 Production of virus

1 ml of free cell supernatant obtained from the COS or PBL cells was ultracentrifuged and the virus sedimented was checked by the standard reverse transcriptase reaction. In some experiments, 100 μ l of cell 30 supernatant was tested for the production of the p24gag protein.

Transfection of the COS cells and coculture with the
CEM cells

D. post-transf.	Reverse transcriptase activity (cpm/ml)	RPL 1	PLG 2	NL 4-3
5	7282	7730	45838	
	3282	5302	326618	
	382	630	ND	
	200	300	ND	

4 \times 10⁶ COS cells were transfected per 7 μ g of plasmid by the calcium coprecipitation technique. The CEM cells were then added in an amount of 4 \times 10⁵ cells/ml in a final volume of 5 ml. After two days of coculture, the CEM cells in suspension were separated from the COS cells in a monolayer. The reverse transcriptase activity in the CEM culture supernatants is given in cpm/ml.

15

Infection of the PBLs

D. post- inf.	Reverse transcri- ptase activity (cpm/ml)	RPL 1	PLG 2	NL4-3
20	734	782	20008	
	202	216		
	262	282		
	454	262		
	204	138		
		RPL 1 + PBL	PLG 2 + PBL	2
1	350	336	276	636
24	230	282	296	284
25	588	510	620	980

2.5 × 10⁶ PBLs were infected with the acellular supernatants of December 19, 1994 obtained after transfection (Table 1) in an amount of 5000 cpm/10⁶ PBL. On day 17 post-infection, 2 × 10⁶ newly isolated PBLs 5 were added to 2 × 10⁶ infected PBLs (RPL 1 + PBL, PLG 2 + PBL). The reverse transcriptase activity in the culture supernatants is given in cpm/ml.

Transfection of the COS cells and coculture with PBLs

10	D. post- transf.	Reverse transcriptase activity (cpm/ml)			
		PLG 2-25	PLG 2-30	PLG 2-95	NL 4-3
	3	2500	8400	3500	2150
	7	446	398	582	53000
	10	174	336	306	74000
	14	730	834	482	45778

15	D. post-transf.	R.T. activity (cpm/ml)	
		RPL 1	PLG 2
	3	20338	22000
	7	682	418
	11	552	466

4 × 10⁶ COS cells were transfected with 7 µg of plasmid by the calcium coprecipitation technique. The PBL cells stimulated with PHA were then added in an amount of 10⁶ cells/ml in a final volume of 5 ml. After two days of 20 coculture, the PBLs in suspension were separated from the COS cells in a monolayer. The reverse transcriptase activity in the PBL culture supernatants is given in cpm/ml.

EXAMPLE 3

25 The aim of this example is to use the selected peptides to detect, in the serum of the patients, antibodies which are potentially inhibitors of HIV (anti-β₂-microglobulin antibodies) and in particular to demon-

strate the presence of protective antibodies in the serum of patients who do not progress. "Patients who do not progress" or "NP" designate patients who have been sero-positive for more than 10 years and who have not 5 developed AIDS, in particular whose T4 cell level is normal.

Materials and methods

1/ The peptides used were synthesized and coupled to BSA by Néosystem (France).

10 2/ The sera of the patients are stored at -20° or -80°C before their use in Elisa.

3/ The second antibodies to human or rabbit Ig's were obtained from Amersham (France). OPD is obtained from Sigma (France).

15 **ELISA with the sera of seropositive patients**

1/ Presence of anti-R7V antibodies in the serum of the patients (titre 1/100 and 1/1000).

20 2/ Of the 46 sera tested from people who do not progress (no viral replication in culture), 16 sera are positive for R7V (37%), 27 remain negative to 1/100 (63%) and 3 sera are impossible to determine (Table 1).

25 3/ Of the 46 patients who do not progress, 34 were tested for the detection of anti-peptide antibodies: R7V, P1, P4, P9. 14 sera are positive for at least one peptide (51.8%) and 13 remain negative to 1/100. Four sera could not be classified positive or negative (Table 2).

Table 1: ELISA R7V with NP sera

	NAME	NUMBER	R7V
	ARA GE	950	Negative
5	ARG CH	150	Not determined
	AUD PA	1509	Negative
	BAT AL	134	Negative
	BAR JE	342	Positive
	BER AL	704	Positive
10	BER SE	1337	Negative
	BES LA	287	Positive
	BEU PH	5.33	Negative
	BOR EM	194	Negative
	BOU NA	5.36	Positive
	BRE FR	20.2.95-5.32	Negative
15	CAB MI	573	Negative
	CAU BE	167/1113	Negative
	CHI OL	353A	Negative
	COU DA	1531	Negative
	DIB AN	872	Positive
20	DUR JE	937	Positive
	GAR AI	986	Negative
	GAS MA	549	Negative
	GUI JE	60	Positive
	GUI PI	26.1.95-2.9	Negative
25	HAN SO	169/5.31	Positive
	HOL CH	4.25	Negative
	IBE JU	6.39	Positive
	IMB PI	327	Not determined
	MAG HE	143	Negative
30	MAN GU	26.1.95-2.8	Negative
	MAN RO	89	Positive
	MAN XA	730	Negative
	MART DO	1412	Negative
	MAS SU	115	Negative
35	MEN JO	622/1382	Positive
	MON NA	1010	Negative
	NIC GE	294	Negative
	OUM NA	1386	Negative
	PAR FR	23.1.95-1.7	Negative
40	MEN JO	622/1382	Positive

POI LI	3.14	Negative
PUJ MA	23.1.95-1.2	Negative
QUI AL	23.1.95-1.5	Negative
RIO EM	3.16	Negative
5 RIS HE	2.10	Negative
ROY CH	5.35	Not determined positive
SAL YA	13.3.95	Negative
SAN NA	2.11	Negative
SAU CH	171/4.27	Positive
10 TEM ST	1343	Positive
VIA JE	701	Not determined
ZUM AM	333	Positive

Table 2: ELISA for the peptides with the NP sera

NAME	NUMBER	POSITIVE/ NEGATIVE	PEPTIDES			
			R7V	P1	P4	P9
BEU PH	5.33	Negative				
BOU NA	5.36	Positive	Pos.	Pos.	Pos.	Neg.
5 BRE FR	20.2.95-532	Positive	Neg.	Pos.	Pos.	Neg.
CIF FR	6.38	Negative (?)				
ETC MA	6.45	(?)				
GEM SA	6.40	(?)				
10 GUI JE	60	Positive	Pos.	Pos.	Neg.	Neg.
GUI PI	26.1.95-2.9	Negative				
HAN SO	169/5.31	Positive	Pos.	Pos.	Neg.	Pos.
HOL CH	4.25	Negative				
IBE JU	6.39	Positive	Pos.	Pos.	Neg.	Neg.
LED DO	4.23	Positive	Neg.	Pos.	Neg.	Neg.
15 MAN GU	26.1.95-2.8	Negative				
MEN JO	622/1382/6.43	Positive	Pos.	Pos.	Pos.	Pos.
MOR JE	5.37	Positive	Neg.	Neg.	Pos.	Neg.
PAR FR	23.1.95-1.7	Negative				
PAT MA	166	Positive	Neg.	Neg.	Pos.	Neg.
20 PIC CH	2.12	(?)				
POI LI	3.14	Negative				
PUJ MA	23.1.95-1.2	Negative				
QUI AL	23.1.95-1.5	Negative				
RIO EM	3.16	Negative				
25 RIS HE	2.10	Negative				
ROY CH	5.35	Positive	Pos.	Pos.	Neg.	Neg.
(?)						
SAL YA	13/3.95	Negative				
SAN NA	2.11	Negative				
SAP MA	4.21	(?)				
30 SAU CH	171/4.27	Positive	Pos.	Pos.	Pos.	
			Pos.	Pos.	Pos.	
			(?)	(?)	(?)	
SEN AN	4.28	Positive	Neg.	Pos.	Neg.	Neg.
TEM ST	5.34	Positive (?)	Pos.	(?)	(?)	(?)
ZUM AM	333	Positive	Pos.	(?)	(?)	(?)

(?) Not determined

EXAMPLE 4

The following trials made it possible to detect antibodies neutralizing various HIV isolates, particularly BRU and NDK, in patients who do not progress, the 5 same patients having anti-R7V antibodies. This makes it possible to show a good correlation between the neutralizing and protective character against HIV of the antibodies generated by the treatments according to the invention.

10 Materials and methods

Culture of the MT4 cells

The MT4 cells are immortalized cells (CD4 +) which are very sensitive to the cytopathogenic effect of HIV-1, originally derived from a T leukaemia in adults. 15 The cells are cultured in the presence of RPMI medium supplemented with 10% of foetal calf serum, 1% of glutamine and 1% of antibiotic.

Culture of the PBLs

The lymphocytes are stimulated for 3 days with 20 phytohemagglutinin P (PHA P) in complete RPMI medium comprising 10% of foetal calf serum, 1% of glutamine, 1% of antibiotic, 2 µg/ml of polybren, 20 IU/ml of interleukin 2 (IL-2). The cells are then washed and cultured in an amount of 10^6 cells/ml in complete RPMI 25 medium.

Neutralization tests

The sera are decomplementized and filtered before they are used in the tests.

Neutralization on MT4

30 The sera are diluted in 24-well plates (Costar) in a total volume of 0.8 ml. the HIV-1 BRU viruses (100 µl of a 10^{-1} dilution of the stock solution) or HIV-1 NDK viruses (100 µl of a 10^{-3} dilution of the stock solution) are added and the mixture is incubated for 1 h 35 30 min at 37°C and 5% CO₂. The cells are then distributed

in an amount of 200 μ l/well and 1.5×10^6 cells/ml. Three days after the infection, the cultures are diluted (1/3) with 10% RPMI medium. The infection of the cells with the HIV-1 viruses is monitored every day under a microscope
5 by observing the formation of syncitia (multinucleated giant cells). The neutralization of the viruses with the different sera is defined by the absence (-) of syncitia or very few syncitia (+/-) compared with the formation of syncitia which is induced by the (+) prototype HIVs.

10 **Neutralization on PBL**

The sera (50 μ l) are mixed with the HIV-1 BRU viruses (50 μ l of a 2×10^{-1} dilution of the stock solution) in 96-well plates and placed for 1 h 30 min at 37°C and 5% CO₂. The mixture is then added to 10^6 PBLs in 24-well plates (Costar) and the culture is maintained for 3 days at 37°C and 5% CO₂. The cells are then washed and cultured in an amount of 10^6 cells/ml in 25 cm² culture flasks. The production of virus is monitored every 3 or 4 days by assaying the "Reverse Transcriptase" enzymatic
15 activity.
20

Assay of the "Reverse Transcriptase" (RT) activity

One ml of centrifuged culture supernatant (1500 rpm), RT, 10 min) is concentrated 100 fold by ultracentrifugation (95000 rpm, 4°C, 5 min) on a TL 100 rotor (Beckman). The pellet obtained is taken up in 10 μ l of NTE buffer - 0.1% Triton X100. The enzymatic reaction is carried out in 50 μ l of the following reaction mixture: 50 mM Tris pH 7.8; 20 mM MgCl₂; 20 mM KCl; 2 mM dithiothreitol; Oligo dT 12-18 0.25 OD/ml; poly rA 0.25
25 OD/ml and 2.5 μ Ci of ³HdTTP. After incubating for 1 h at 37°C, the reaction products are precipitated with 20% trichloroacetic acid, filtered on Millipore membranes and the β radioactivity is measured. The results are expressed in CMP/ml.
30

35 **Report for the neutralization experiments**

Antibodies directed against the peptide R7V were

detected in the sera of HIV + patients by means of a specific ELISA developed by the Applicant. A search was made in these sera for the existence of a neutralizing activity directed against the two prototype virus strains
5 HIV-1 BRU and NDK. Two neutralization tests were carried out, one on an MT4 cell line (followed by the formation of syncitia) and the other on healthy peripheral blood lymphocytes, PBL (followed by the "Reverse Transcriptase" enzymatic activity).

10 Results obtained on MT4

Of the 13 patients tested, a neutralizing serum activity was detected for 6 of them (Tables 3 to 5):

- two sera neutralize HIV-1 NDK:
 - ZUM AM (ELISA positive)
 - COC PH (ELISA negative)
- two sera neutralize HIV-1 BRU:
 - MEC EV (ELISA positive)
 - OUA VE (ELISA negative)
- two sera neutralize HIV-1 BRU and HIV-1 NDK:
 - SAU CH (ELISA positive)
 - BUB JE (ELISA positive)

Results obtained on PBL

The experiment was carried out with the sera of MEC EV, SAU CH and BUB JE (1/50) as well as with a serum from a seronegative individual. No neutralizing activity was detected for the SAU CH serum as well as for the seronegative serum. On the other hand, a neutralizing activity against the two prototype viruses HIV-1 BRU and NDK was detected for the sera MEC EV and BUB JE (Figures
25 30 6 to 13).

EXAMPLE 5

Method which makes it possible to detect equivalent peptides

Effect of selected peptides on the neutralization of HIV-

5 1 NDK by anti-B1G6 β2 monoclonal antibodies

Protocol

The peptides at a concentration of 100 µg/ml or 50 µg/ml (40 µl or 20 µl of the stock solution and 5 mg/ml) are preincubated with 5 µg/ml of B1G6 (10 µl of a stock solution at 1 mg/ml) in a total volume of 110 µl for 2 hours, in tubes on a water bath at 37°C, with gentle stirring. Next, HIV-1 NDK is added (100 µl of a 2 × 10⁻⁴ dilution of a stock solution and the tubes are incubated for 1 hour at 37°C on a water bath. The tubes 10 are then separated into two and each 100 µl is added to 10⁶ PBLs on a 24-well plate. The cells are cultured for 3 days at 37°C under an atmosphere with 5% CO₂. On day 3, the cells are washed, placed in culture and propagated for at least 20-25 days in a 25 cm³ round-bottomed flask. 15 The production of virus is monitored every 3 or 4 days by the assay of reverse transcriptase (RT). 20

Results

The peptides R7V and F7E can cancel the neutralizing effect of the monoclonal antibody B1G6 on 25 the productin of HIV-1 NDK by the PBLs. The sequence of the R7V peptide was modified and among the 6 new peptides (185, 186, 187, 188, 189, 190), 3 lost the canceling effect of R7V: peptides 185, 189 and 190).

Table 3

		NDK						
		Day / Post-infection						
		D4	D5	D6	D7			
HIV+	ZUM AM	1/25	1/50	1/100	1/25	1/50	1/100	1/25
HAN SO	-	-	-	-	-	-	-	-
SAU CH	-	-	-	+	+	+/-	+	+
MEN JO	-	-	-	+/-	-	+/-	+	+/-
PAT MA	+/-	-	-	+/-	-	+/-	-	+/-
COC PH	-	-	-	-	-	-	-	-
HIV-	SER C	-	-	+	+	+	+	+
DOU S	-	-	-	+	+	+	+	+
AUB V	-	-	-	+	+	+	+	+
NDK 10^-4		+/-		+/-		+/-		+

Table 4a

		Day / Post-infection						
		NDK		D4 D5 D6 D7				
		1/50	1/100	1/50	1/100	1/50	1/100	1/50
HIV+	ZUM AM	-	+/-	+	+	+	+	+
	HAN SO	+	+/-	+	+	+	+	+
	SAU CH	+	+	+	+	+	+	+
	MEN JO	+	+	+	+	+	+	+
	MEC EV	+/-	-	+/-	+	+	+	+
	PAT MA	+/-	+/-	+/-	+	+	+	+
	COC PH	+/-	-	+/-	-	+	+	+
HIV-	AUB V	+	+/-	+	+	+	+	+
	NDK 10 ⁻⁴	+			+			+

Table 4b

		Day / Post-infection						BRU	
		D4		D5		D6		D7	
		1/50	1/100	1/50	1/100	1/50	1/100	1/50	1/100
HIV+	ZUM AM	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
	HAN SO	+/-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
	SAU CH	+	+	+	+	+	+	+	+
	MEN JO	-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
	MEC EV	-	-	-	-	-	-	-	-
	PAT MA	+/-	-	+/-	+/-	+/-	+/-	+/-	+/-
	COC PH	-	+/-	+/-	+/-	+/-	+/-	+/-	+/-
HIV-	AUB V	+	+	+	+	+	+	+	+
	BRU 10^-2		+/-			+/-		+/-	

Table 5a

		Day / Post-infection							NDK				
		D4			D5			D6			D7		
		1/25	1/50	1/100	1/25	1/50	1/100	1/25	1/50	1/100	1/25	1/50	1/100
HIV+	ZUM AM	-	+/-	+/-	-	+/-	+	-	+	+	-	+	+
	MEC EV	-	-	-	+	+/-	-	+	+	+	+	+	+
	SAU CH	-	+/-	+/-	-	-	-	-	-	+/-	-	-	+
	OUA VE	-	-	+/-	-	+/-	+	+/-	+	+	+	+	+
	QUI AL	+/-	+/-	+/-	+	+	+	+	+	+	+	+	+
	BUB JE	+/-	-	+/-	-	+/-	+/-	-	+	+	+	+	+
	PUJ MA	+/-	+/-	+/-	+/-	+/-	+	+/-	+/-	+/-	-	+/-	+
	SEN AN	+/-	+/-	+	+	+	+	+	+	+	+	+	+
	RIO EM	+/-	+/-	+/-	+	+	+	+	+	+	+	+	+
HIV-	AUB V	+	+	+	+	+	+	+	+	+	+	+	+
	NDK 10^-4		+/-				+/-			+/-			+

Table 5b

		Day / Post-infection							BRU	
		D4			D5		D6		D7	
		1/25	1/50	1/100	1/25	1/50	1/100	1/25	1/50	1/100
HIV+	ZUM AM	-	+/-	+	+	+	+	+	+	+
	MEC EV	-	-	-	-	-	-	-	-	+/-
	SAU CH	-	-	-	-	-	-	-	-	+
	OUA VE	-	-	-	-	+/-	-	-	-	+
	QUI AL	-	-	-	-	-	+	+/-	+	+
	BUB JE	-	-	-	-	-	-	+/-	+/-	+
	PUJ MA	-	-	+/-	+/-	+	+	+	+	+
	SEN AN	-	-	+/-	+/-	+/-	+	+	+	+
	RIO EM	+/-	+/-	+/-	+/-	+	+	+	+	+
HIV-	AUB V	+	+	+/-	+/-	+	+	+	+	+
	BRU 10 ⁻²			+		+	+	+	+	+

SEQUENCE LISTING

Information for SEQ ID No. 1

TYPE: amino acid

LENGTH: 15 amino acids

5 TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 1

Ile-Gln-Arg-Thr-Pro-Lys-Ile-Gln-Val-Tyr-Ser-Arg-His-Pro-
Ala

Information for SEQ ID No. 2

10 TYPE: amino acid

LENGTH: 15 amino acids

TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 2

Phe-His-Pro-Ser-Asp-Ile-Glu-Val-Asp-Leu-Leu-Lys-Asp-Gly-
15 Glu

Information for SEQ ID No. 3

TYPE: amino acid

LENGTH: 15 amino acids

TOPOLOGY: linear

20 SEQUENCE DESCRIPTION: SEQ ID No. 3

Ala-Cys-Arg-Val-Asn-His-Val-Thr-Leu-Ser-Gln-Pro-Lys-Ile-
Val

Information for SEQ ID No. 4

TYPE: amino acid

25 LENGTH: 7 amino acids

TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 4

Arg-Thr-Pro-Lys-Ile-Gln-Val

Information for SEQ ID No. 5

5 TYPE: amino acid

LENGTH: 7 amino acids

TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 5

Ser-Gln-Pro-Lys-Ile-Val-Lys

10 Information for SEQ ID No. 6

TYPE: amino acid

LENGTH: 7 amino acids

TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 6

15 Phe-His-Pro-Ser-Asp-Ile-Glu

Information for SEQ ID No. 7

TYPE: amino acid

LENGTH: 10 amino acids

TOPOLOGY: linear

20 SEQUENCE DESCRIPTION: SEQ ID No. 7

Thr-Leu-Ser-Arg-Thr-Pro-Lys-Ile-Gln-Val

Information for SEQ ID No. 8

TYPE: amino acid

LENGTH: 10 amino acids

TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 8

Ile-Tyr-Leu-Thr-Gln-Pro-Lys-Ile-Lys-Val

5 Information for SEQ ID No. 9

TYPE: amino acid

LENGTH: 10 amino acids

TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 9

10 Ile-Gln-Arg-Thr-Pro-Lys-Ile-Gln-Val-Tyr

Information for SEQ ID No. 10

TYPE: amino acid

LENGTH: 10 amino acids

TOPOLOGY: linear

15 SEQUENCE DESCRIPTION: SEQ ID No. 10

Thr-Leu-Ser-Gln-Pro-Lys-Ile-Val-Lys-Asn

Information for SEQ ID No. 11

TYPE: amino acid

LENGTH: 10 amino acids

20 TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 11

Ile-Gln-Arg-Thr-Pro-Gln-Ile-Val-Lys-Trp

Information for SEQ ID No. 12

TYPE: amino acid
LENGTH: 10 amino acids
TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 12

5 Ile-Gln-Arg-Thr-Pro-Asn-Ile-Val-Lys-Trp

Information for SEQ ID No. 13

TYPE: amino acid
LENGTH: 8 amino acids
TOPOLOGY: linear

10 SEQUENCE DESCRIPTION: SEQ ID No. 13

Cys-Tyr-Asn-Pro-Ser-Asp-Ile-Glu

Information for SEQ ID No. 14

15 TYPE: amino acid
LENGTH: 7 amino acids
TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 14

Tyr-Cys-Asn-Pro-Glu-Ser-Thr

Information for SEQ ID No. 15

20 TYPE: amino acid
LENGTH: 8 amino acids
TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 15

Asn-Phe-Leu-Asn-Cys-Tyr-Val-Ser

Information for SEQ ID No. 16

TYPE: amino acid

LENGTH: 9 amino acids

TOPOLOGY: linear

5 SEQUENCE DESCRIPTION: SEQ ID No. 16

Leu-Asn-Cys-Tyr-Val-Ser-Pro-Ser-Asp

Information for SEQ ID No. 17

TYPE: amino acid

LENGTH: 7 amino acids

10 TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 17

Lys-Thr-Pro-Gln-Ile-Gln-Val

Information for SEQ ID No. 18

TYPE: amino acid

15 LENGTH: 7 amino acids

TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 18

Phe-His-Pro-Pro-Gln-Ile-Glu

Information for SEQ ID No. 19

20 TYPE: amino acid

LENGTH: 7 amino acids

TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 19

Phe-His-Pro-Pro-His-Ile-Glu

Information for SEQ ID No. 20

TYPE: amino acid

LENGTH: 7 amino acids

TOPOLOGY: linear

5 SEQUENCE DESCRIPTION: SEQ ID No. 20

Ala-Glu-Pro-Lys-Thr-Val-Tyr

Information for SEQ ID No. 21

TYPE: amino acid

LENGTH: 7 amino acids

10 TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 21

Ser-Gln-Pro-Lys-Thr-Val-Tyr

Information for SEQ ID No. 22

TYPE: amino acid

15 LENGTH: 10 amino acids

TOPOLOGY: linear

SEQUENCE DESCRIPTION: SEQ ID No. 22

Ile-Leu-Ser-Arg-Thr-Pro-Lys-Ile-Gln-Val

LEGEND TO THE FIGURES

LEGEND TO FIGURE 1A

- | | | |
|-------------------------------------|------|------|
| <input checked="" type="checkbox"/> | J63 | d100 |
| <input checked="" type="checkbox"/> | J132 | d100 |

LEGEND TO FIGURE 1B

- | | | |
|-------------------------------------|------|------|
| <input checked="" type="checkbox"/> | J63 | d100 |
| <input checked="" type="checkbox"/> | J132 | d100 |

5 LEGEND TO FIGURE 2

ELISA with rabbit antiserum for R7V or β 2m
rabbit 618 (immunization with R7V-KLH) serum dilution
1/100

- | | |
|-------------------------------------|--------------|
| <input checked="" type="checkbox"/> | IMMUNE SERUM |
| <input checked="" type="checkbox"/> | J63 pi |
| <input checked="" type="checkbox"/> | J132 pi |

LEGEND TO FIGURE 3A

10 ELISA with rabbit antiserum on wells coated with peptide

- | | |
|-------------------------------------|-------------------------------|
| <input checked="" type="checkbox"/> | rabbit 618 immunized with R7V |
| <input checked="" type="checkbox"/> | rabbit 621 immunized with F7E |
| <input checked="" type="checkbox"/> | rabbit 624 immunized with S7K |

LEGEND TO FIGURE 3B

ELISA with sera of immunized rabbits

- rabbit 618
- rabbit 619
- rabbit 620

LEGEND TO FIGURE 3C

5 ELISA with the sera of immunized rabbits

- rabbit 621
- rabbit 622
- rabbit 623

LEGEND TO FIGURE 3D

ELISA with sera of immunized rabbits

- rabbit 624
- rabbit 625
- rabbit 626

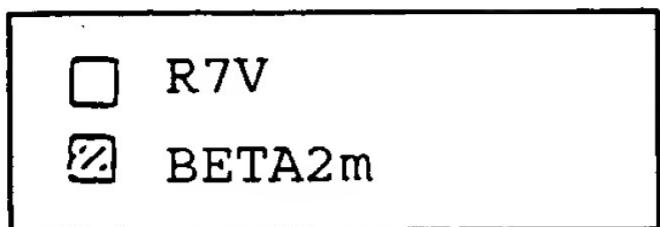
LEGEND TO FIGURE 4

ELISA with B1G6, C21.43, B2G2.2 mAb for R7V

- B1G6
- C21.48
- B2G2.2

LEGEND TO FIGURE 5

ELISA FOR R7V-BSA OR B2



LEGEND TO FIGURE 6

5 NEUTRALIZATION OF HIV-1 BRU-1 WITH THE SERUM MEC EV
(1/50) ON PBL

MEC EV 50 ──▲──
 MEC EV 50' ──▲'──
 BRU ──★──
 10 ──★'──
 BRU'

LEGEND TO FIGURE 7

NEUTRALIZATION OF HIV-1 BRU-1 WITH THE SERUM OF BUB JE
(1/50) ON PBL

BUB JE 50 ──▲──
 15 BUB JE 50' ──▲'──
 BRU ──★──
 BRU' ──★'──

LEGEND TO FIGURE 8

EFFECT OF THE SERUM SAU CH (1/50) ON THE PRODUCTION OF HIV-1 BRU-1 ON PBL

- 5 \triangle SAU CH 50
 \triangle SAU CH 50'
 \star BRU
 \star BRU'

LEGEND TO FIGURE 9

- 10 EFFECT OF A SERUM OF AN HIV- PATIENT ON THE PRODUCTION OF HIV-1 ON PBL

- 15 \triangle SN5
 \triangle SN5'
 \star BRU
 \star BRU'

LEGEND TO FIGURE 10

NEUTRALIZATION OF HIV-1 NDK WITH THE SERUM MEC EV (1/50)
ON PBL

- 20 \triangle MEC EV 50
 \triangle MEC EV 50'
 \star NDK 5-4

LEGEND TO FIGURE 11

NEUTRALIZATION OF HIV-1 NDK WITH THE SERUM BUB JE (1/50)
ON PBL

- 5 BUB JE 50
 BUB JE 50'
 NDK 5-4

LEGEND TO FIGURE 12

10 EFFECT OF THE SERUM SAU CH (1/50) ON THE PRODUCTION OF
HIV-1 NDK ON PBL

- SAU CH 50
 SAU CH 50'
 NDK 5-4

LEGEND TO FIGURE 13

15 EFFECT OF A SERUM OF AN HIV- PATIENT ON THE PRODUCTION OF
HIV-1 NDK ON PBL

- SN5 50
 SN5 50'
 NDK 5-4

CLAIMS

1. Vaccine intended for the treatment and/or prevention of diseases of infectious origin, the infectious agent having at least one intracellular phase in the host during its multiplication cycle, characterized in that it comprises at least one cryptic epitope of a cellular component carried away by an intracellular infectious agent during its passage outside the cell and which is exposed by the infectious agent.
5. 2. Vaccine according to Claim 1, characterized in that the infectious agent consists of an intracellular parasite or an enveloped virus.
10. 3. Vaccine according to Claim 2, characterized in that the virus is chosen from HIV, CMV and HPV.
15. 4. Composition intended for the treatment or for the prevention of HIV infections, characterized in that it comprises, as active ingredient, at least one peptide corresponding to sequences id No. 1 to 22 or an equivalent sequence.
20. 5. Composition according to Claim 4, characterized in that the peptide is bound to a carrier system.
6. 25. Composition according to Claim 5, characterized in that the carrier system consists of one or more protein fragments linked to the N- or C-terminal end of the peptide by a peptide bond.
7. 30. Composition according to Claim 4, characterized in that the carrier system is linked to the peptide by a nonpeptide bond.
8. 35. Composition according to one of Claims 4 to 7, characterized in that the peptide has the R7V sequence.
9. 10. Composition according to one of Claims 4 to 8, characterized in that it comprises several peptides.
11. 12. Composition according to one of Claims 4 to 10, characterized in that it comprises, in addition, nonspecific immunity adjuvants.
12. Composition intended for the treatment and

prevention of HIV infections, characterized in that it comprises a DNA sequence encoding a peptide according to one of the sequences id No. 1 to 22 or an equivalent sequence.

- 5 13. Composition according to Claim 12, characterized in that the DNA sequence encodes a peptide carrying the peptide sequence, sequence id No. 1 to 22 or an equivalent sequence.
- 10 14. Composition according to Claim 13, characterized in that the DNA sequence is preceded by the sequence ensuring its expression in a host cell.
- 15 15. Composition according to one of Claims 12 to 14, characterized in that the DNA sequence is carried by an expression vector.
- 15 16. Composition according to Claim 15, characterized in that the expression vector is in autonomous replication.
- 20 17. Composition according to Claim 15, characterized in that the expression vector is a vector for chromosomal integration.
18. Composition according to one of Claims 15 to 17, characterized in that the expression vector is a bacterial plasmid.
- 25 19. Composition according to one of Claims 15 to 18, characterized in that the expression vector consists of all or part of a defective and/or nonpathogenic virus.
20. 20. Composition according to one of Claims 1 to 19, characterized in that the peptide is expressed in a host cell.
- 30 21. Composition according to Claim 20, characterized in that said cell is a eukaryotic or plant cell.
22. Antibodies directed against a peptide used in one of the compositions according to one of Claims 1 to 21.
23. Composition comprising at least one antibody according to Claim 22.
- 35 24. Method for diagnosing patients who do not progress, characterized in that the presence of antibodies according to Claim 19 is detected by an immunological test.

25. Method according to Claim 24, characterized in that the immunological test is an ELISA or RIA test.



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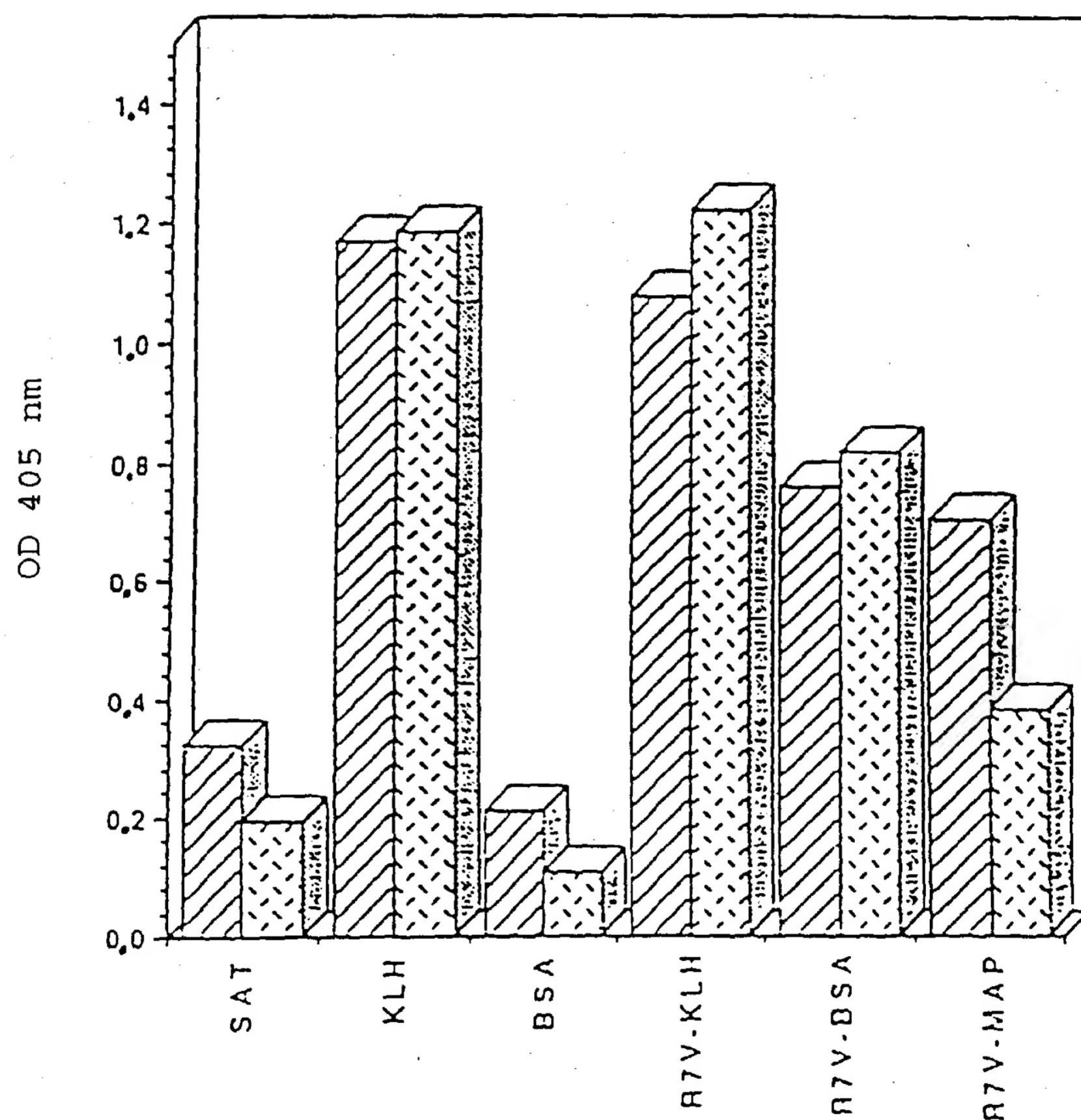


FIG. 1A



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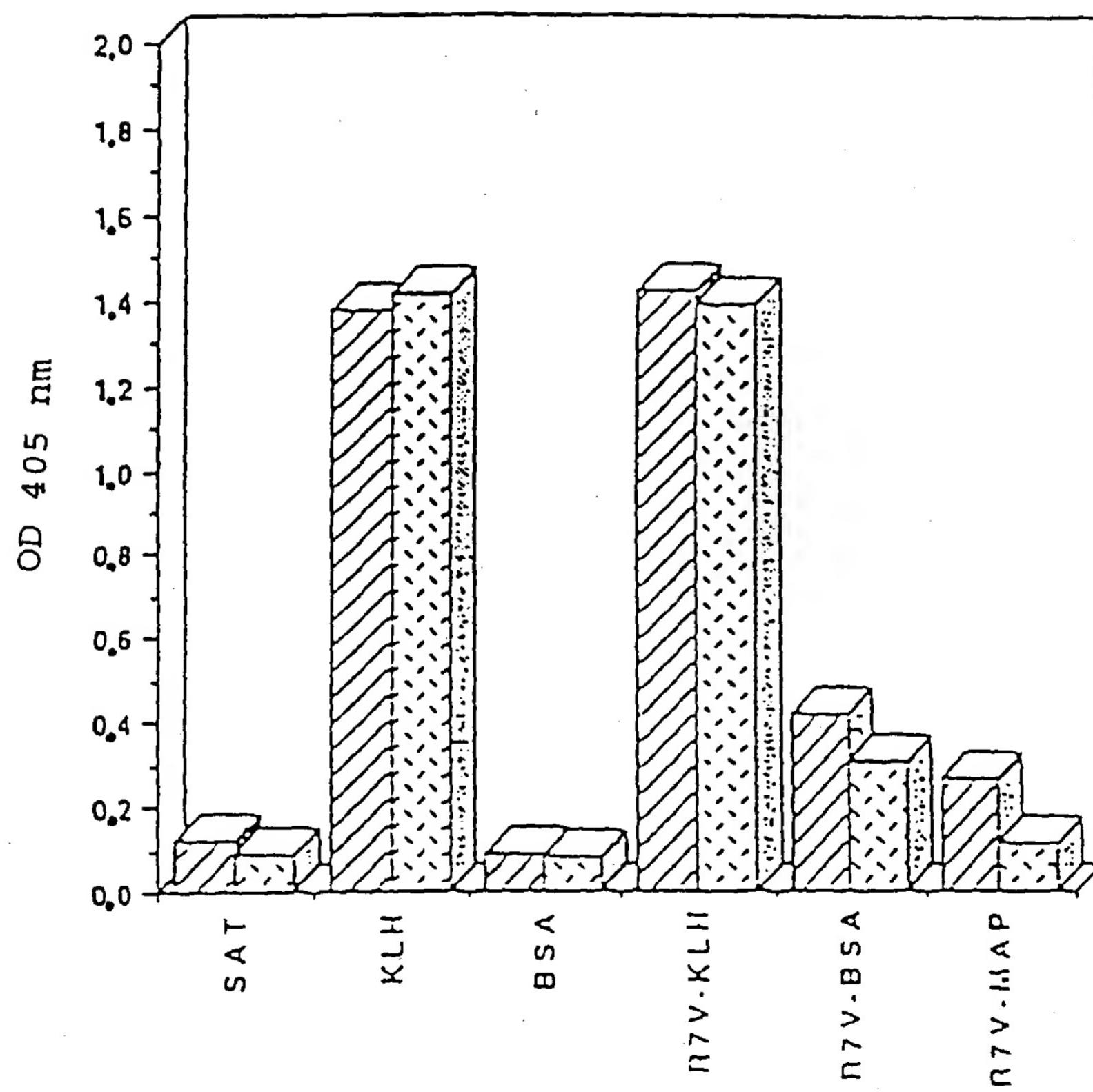


FIG. 1B



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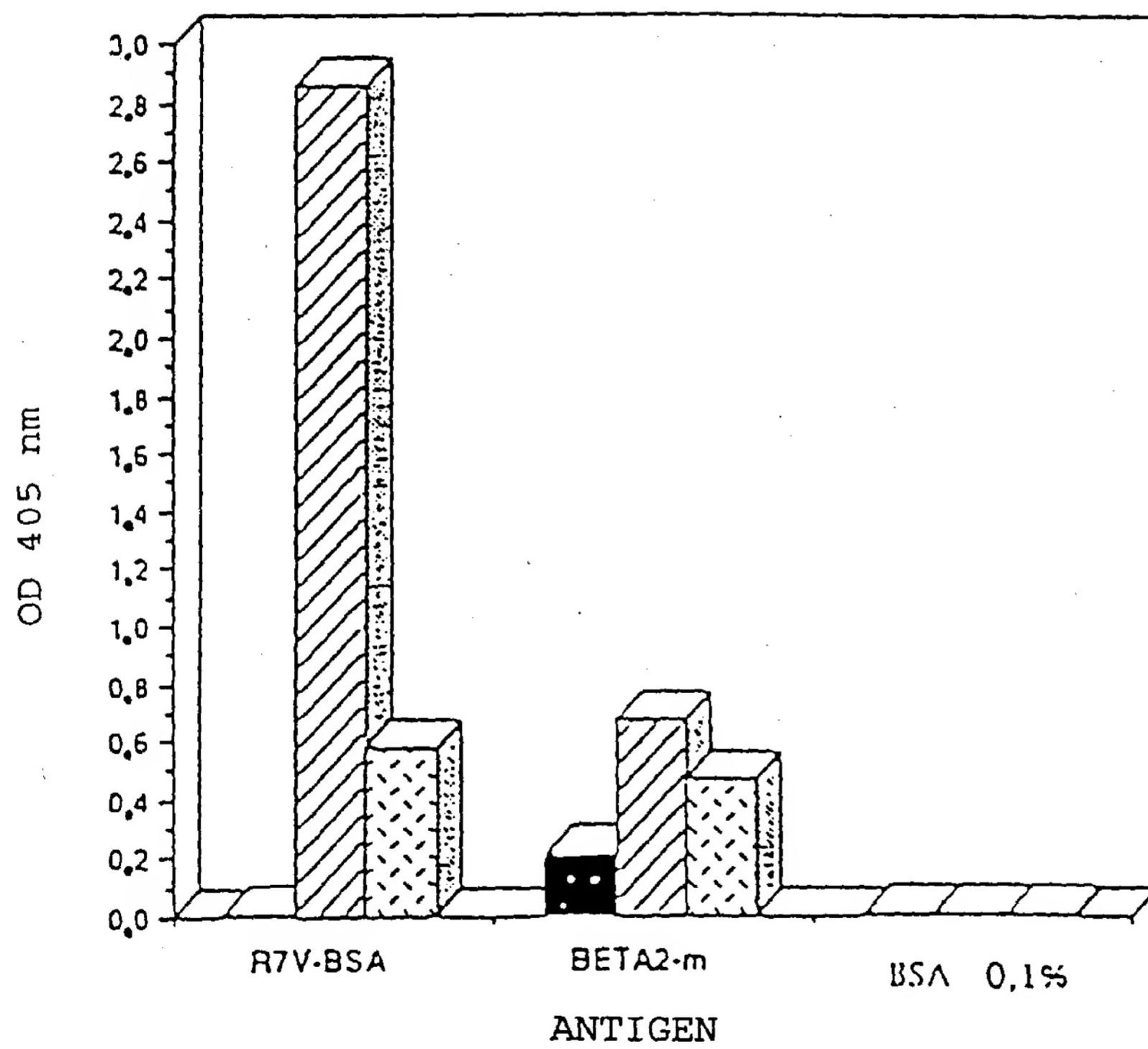


FIG. 2

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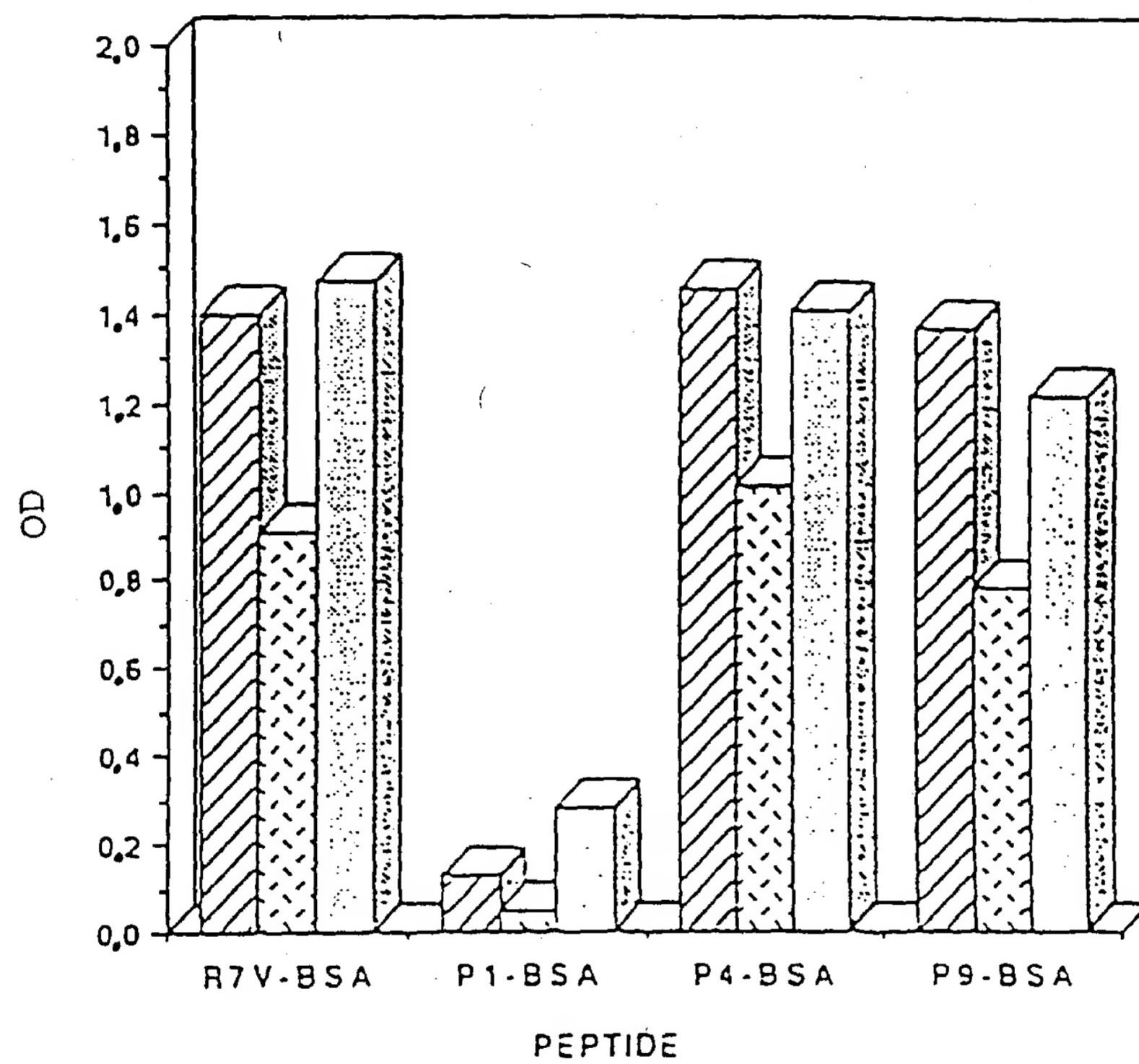


FIG. 3A



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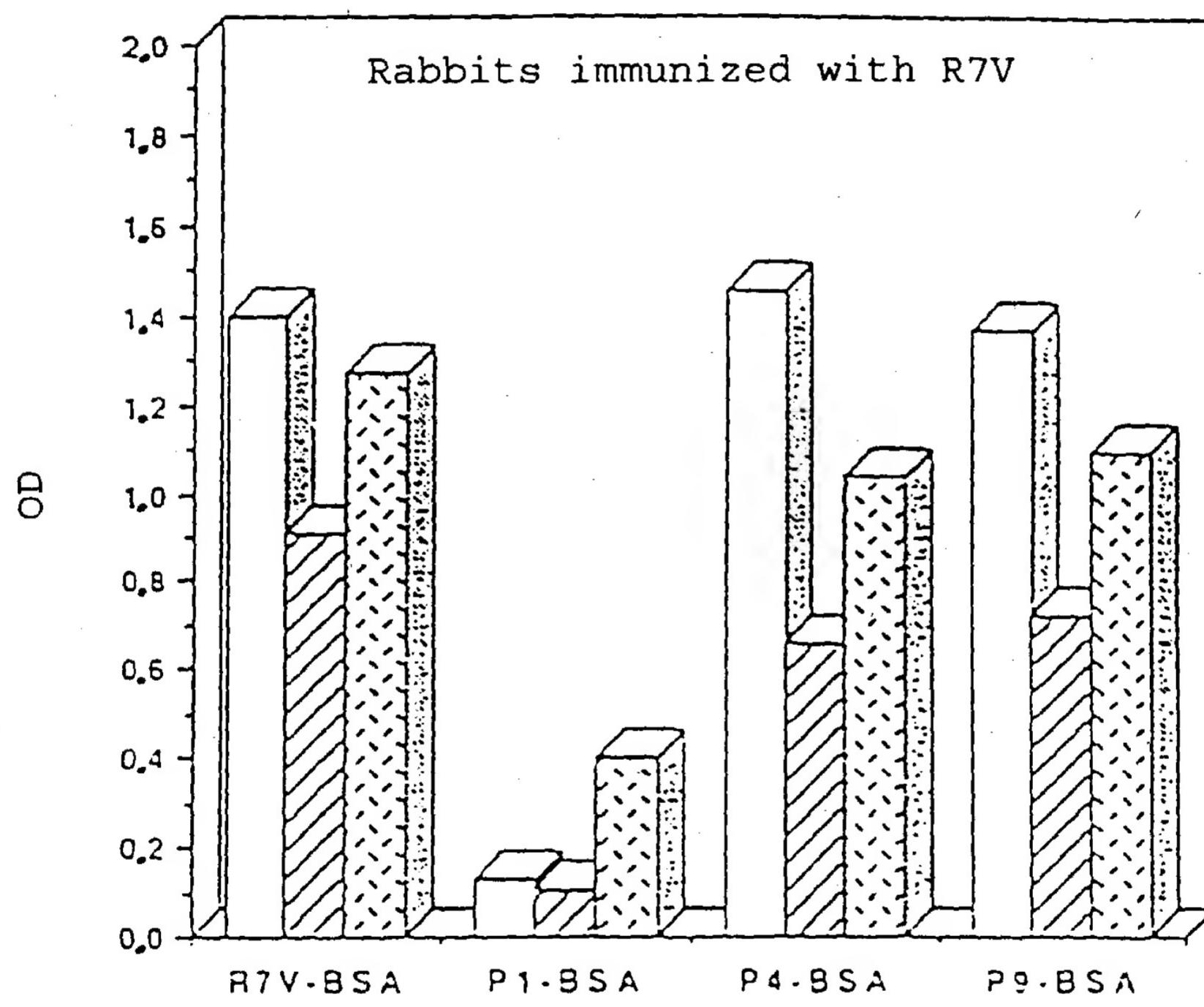
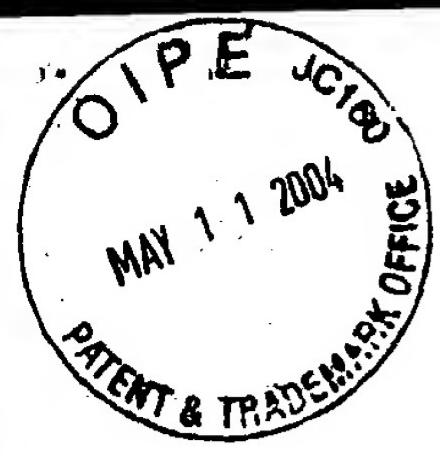


FIG. 3B



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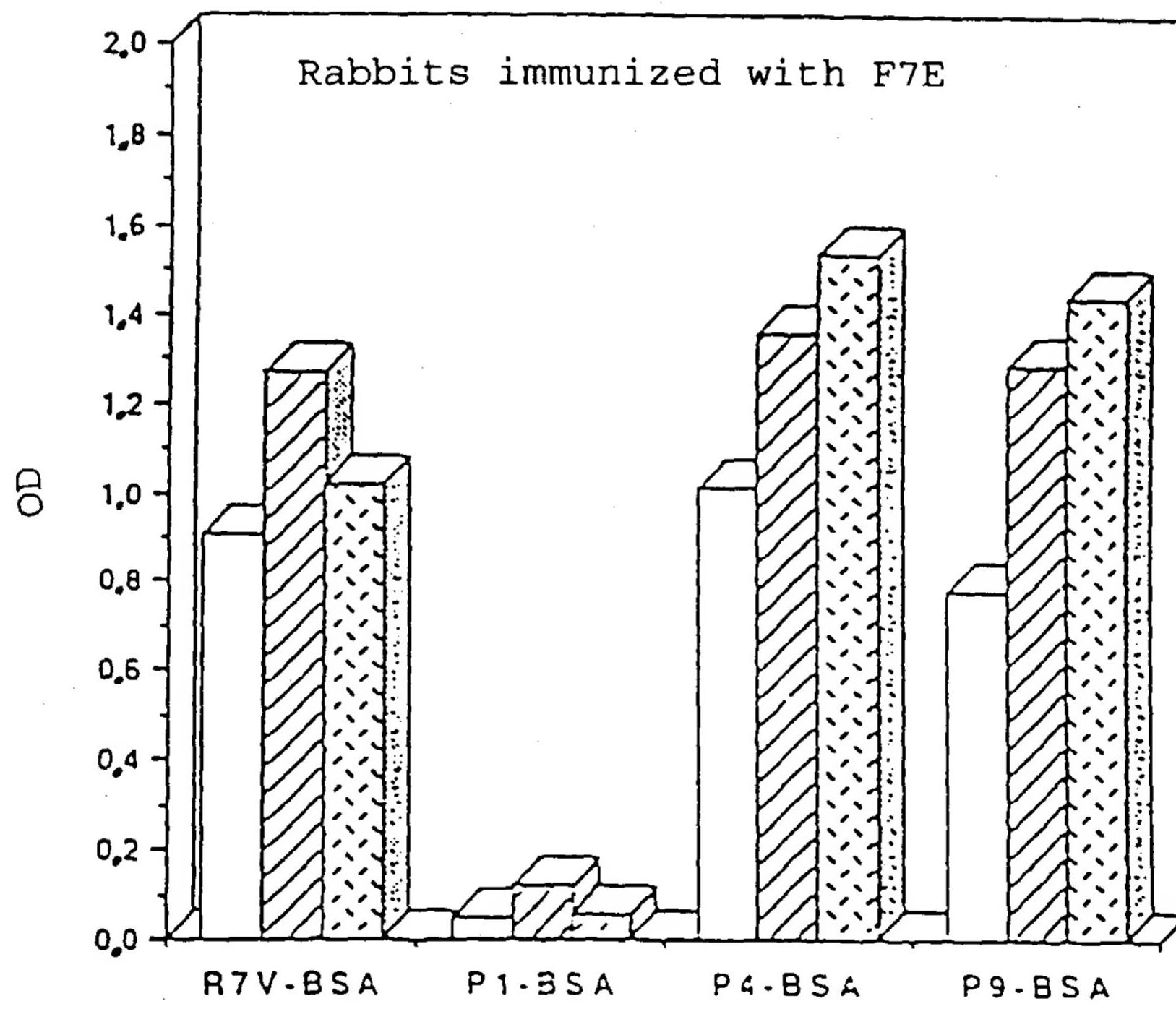


FIG. 3C



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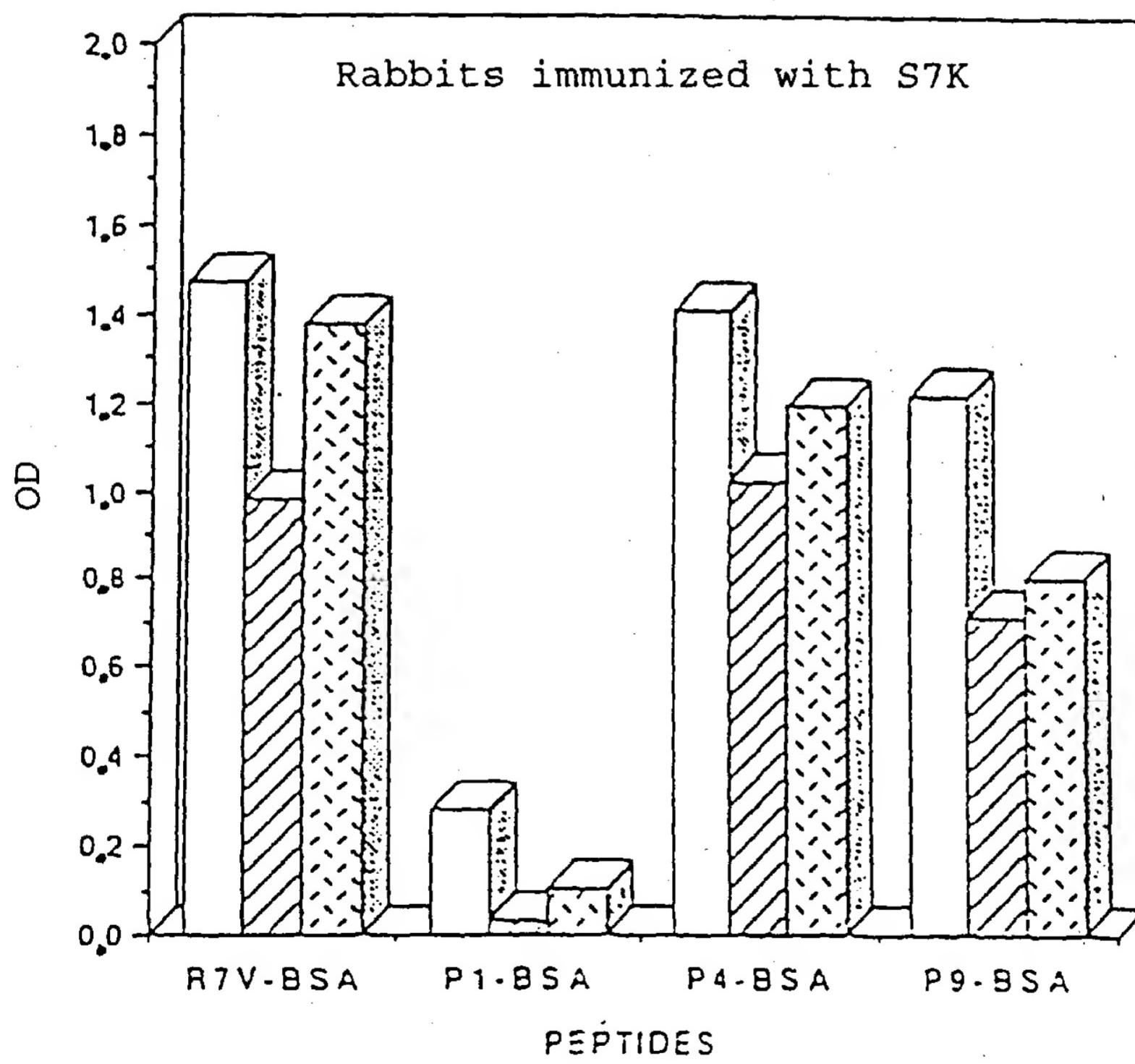


FIG. 3D



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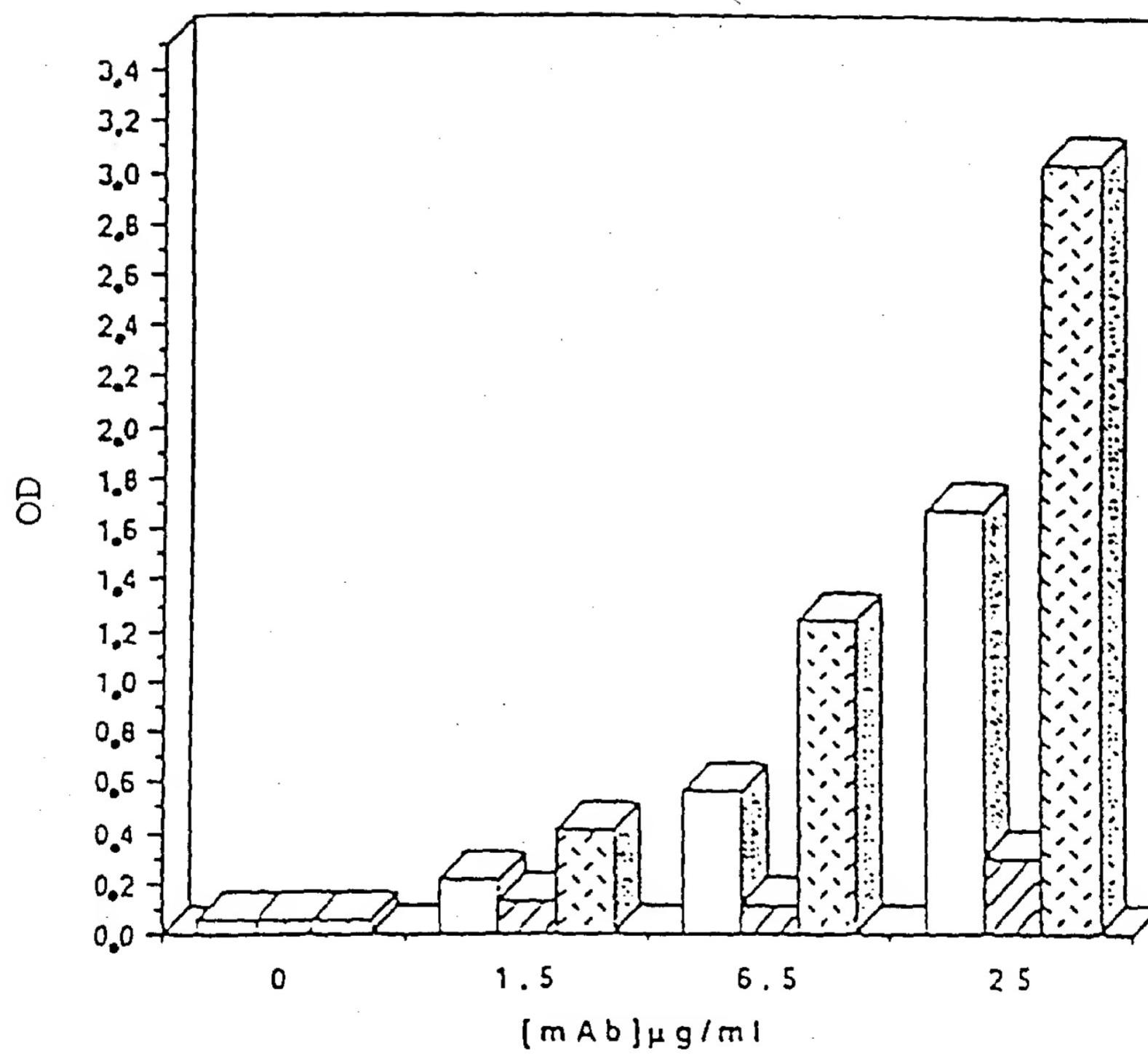


FIG. 4



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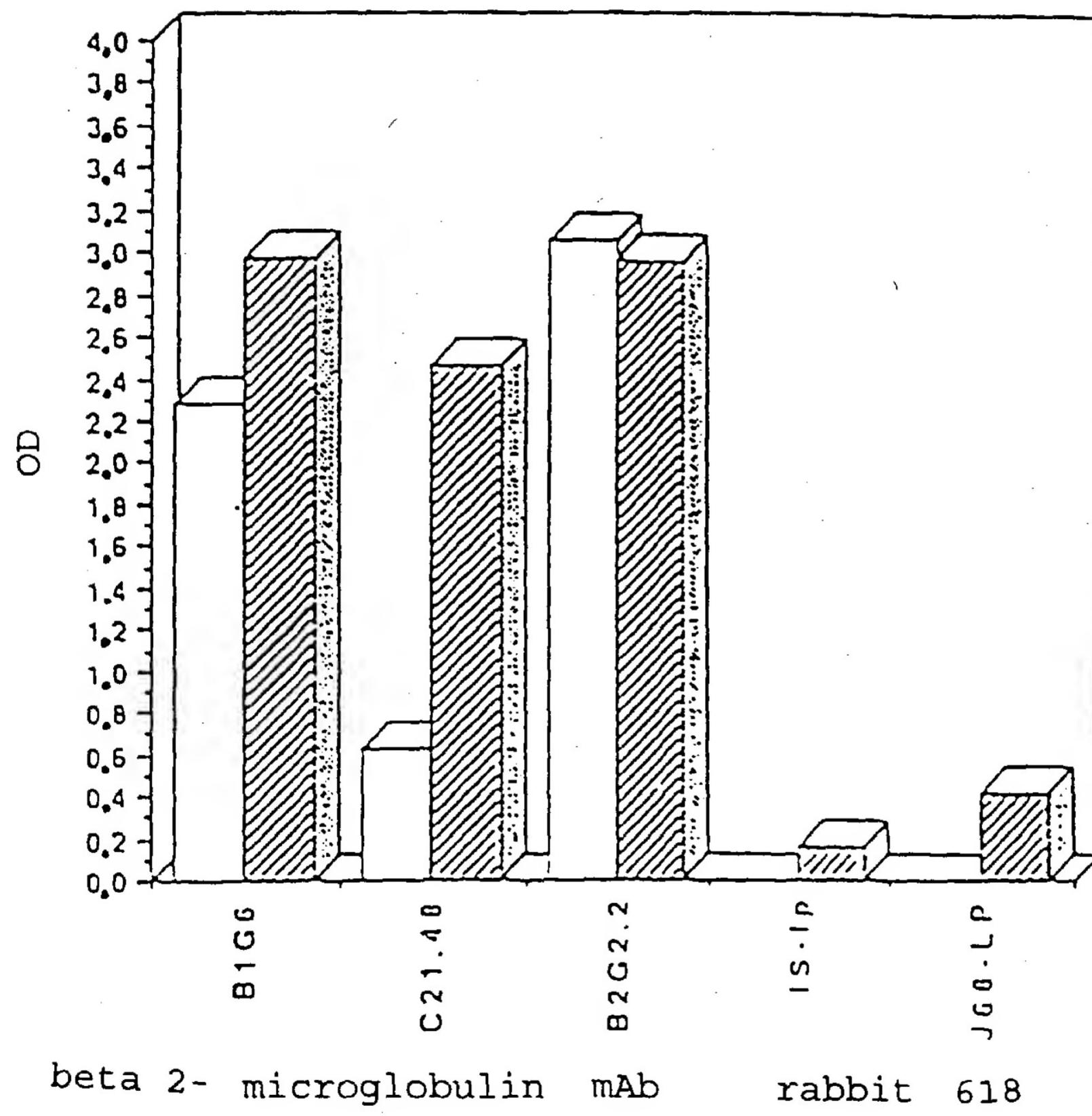


FIG. 5



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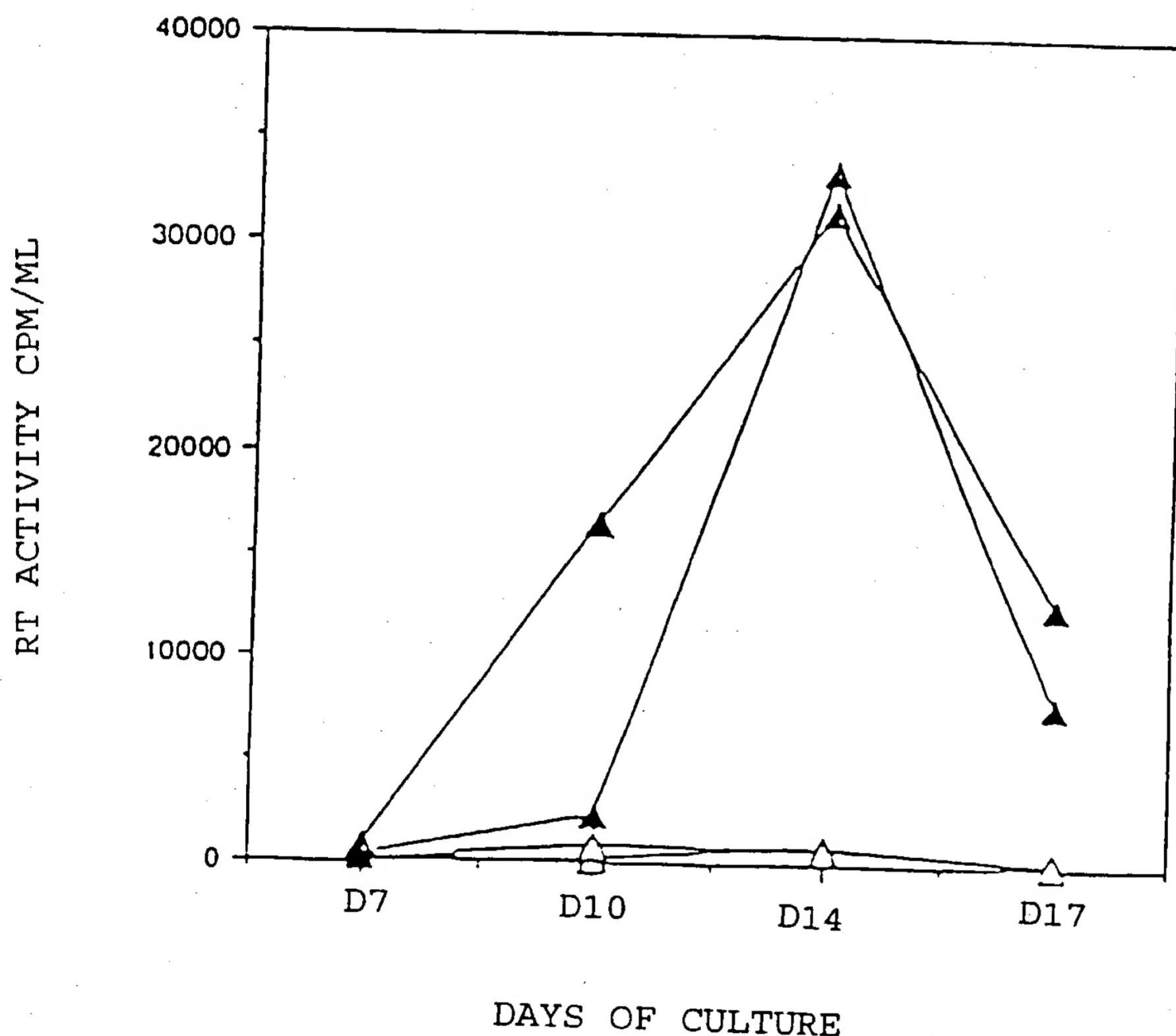


FIG. 6



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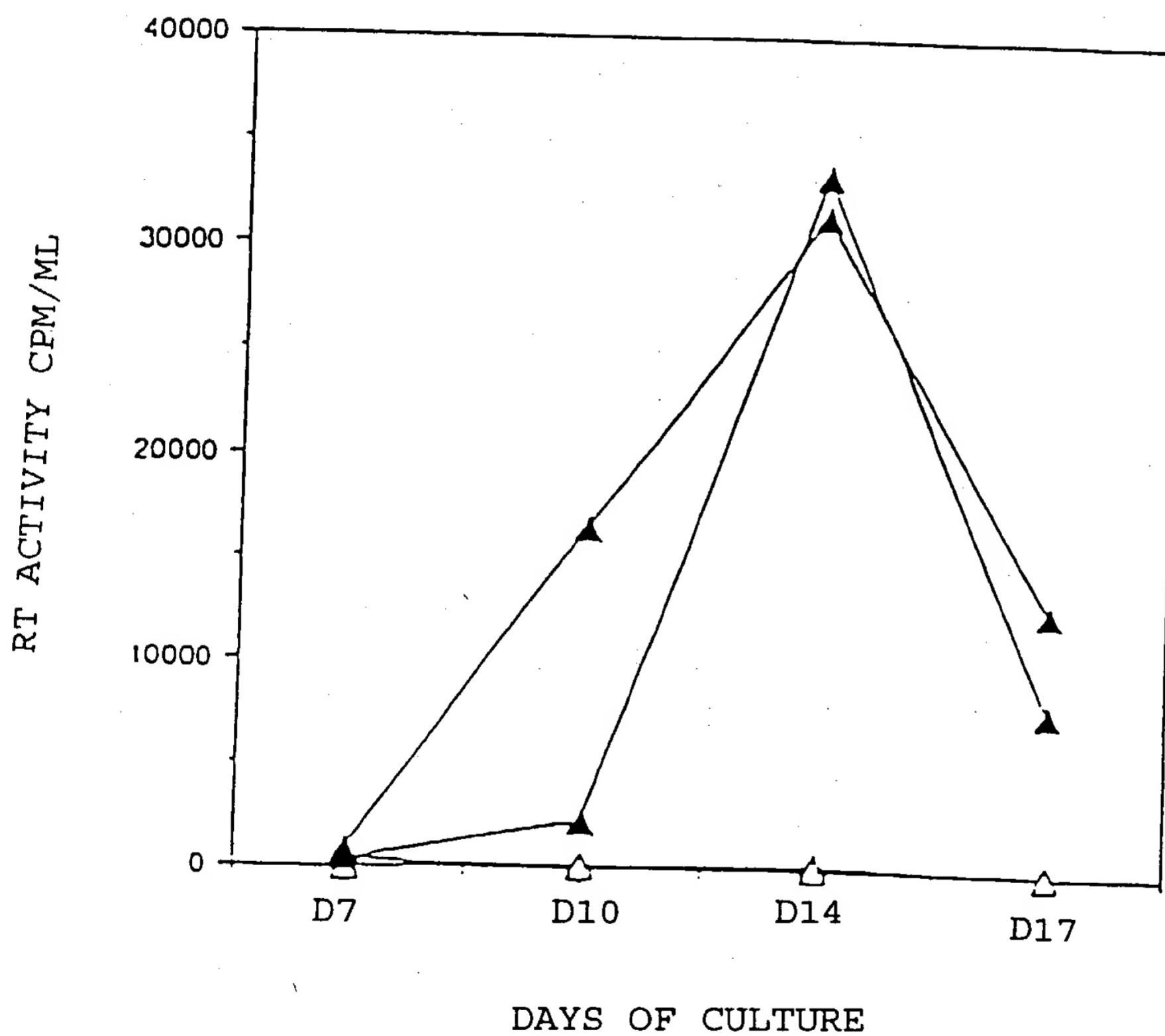


FIG. 7



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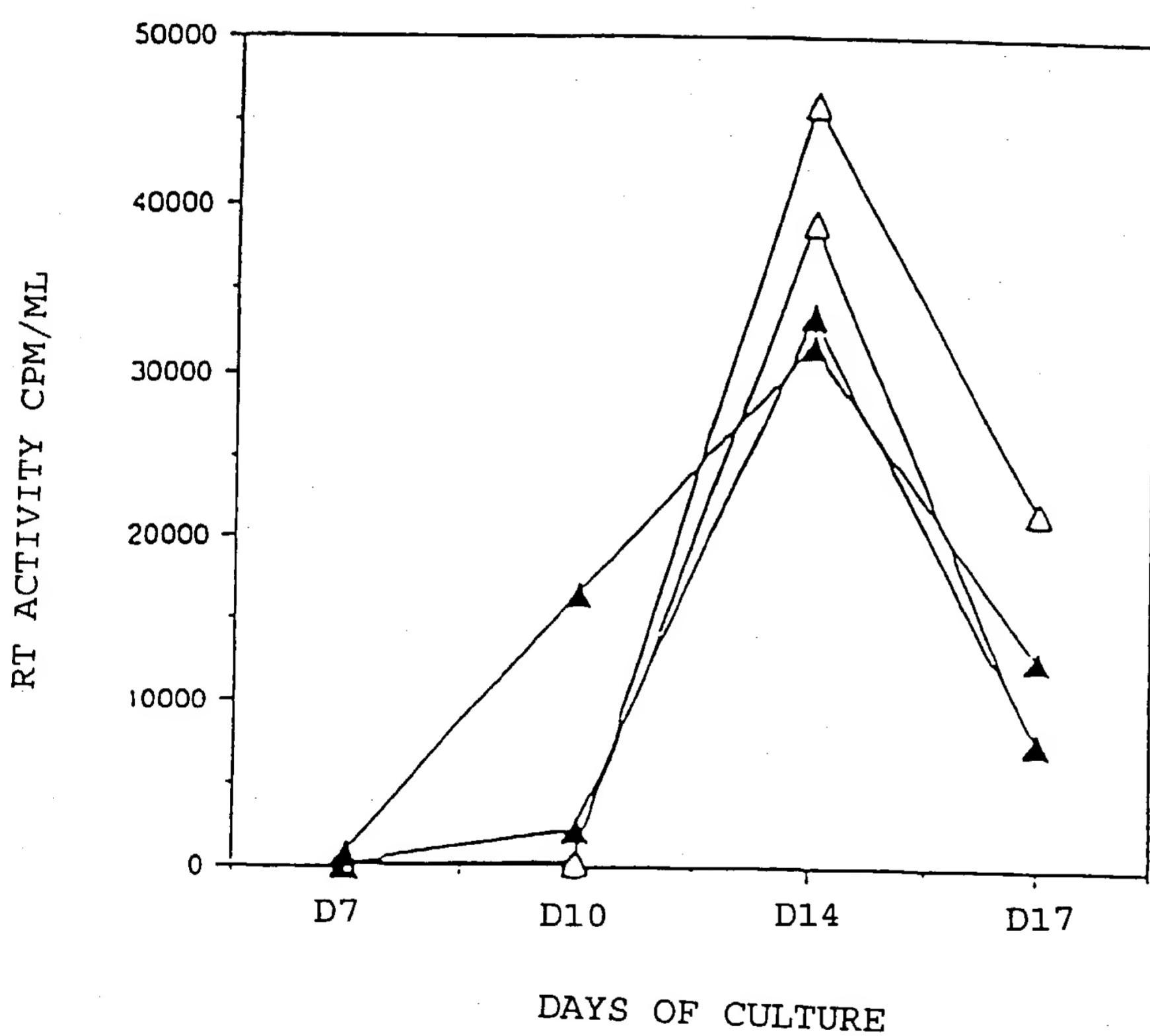


FIG. 8



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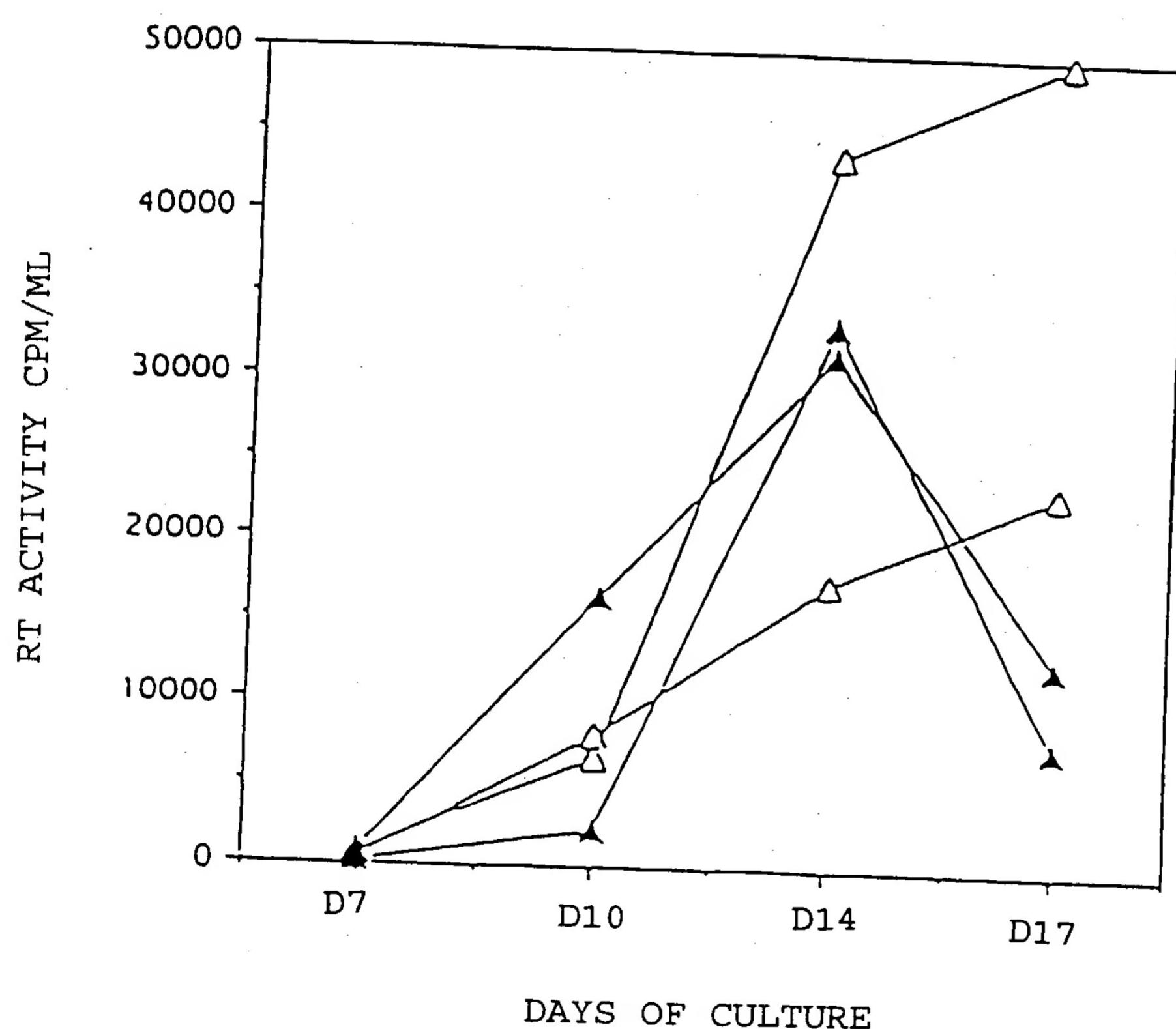


FIG. 9



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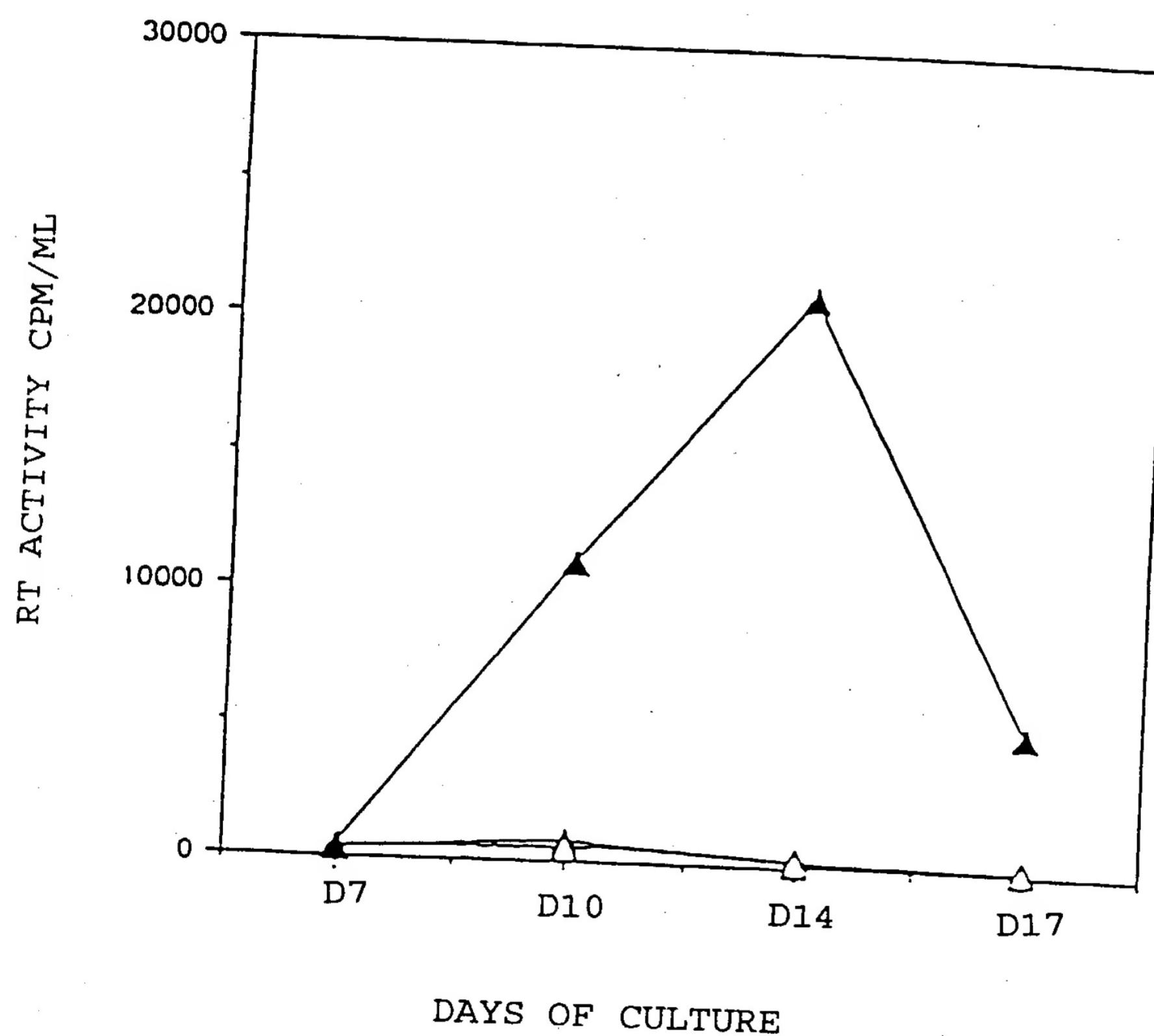


FIG. 10



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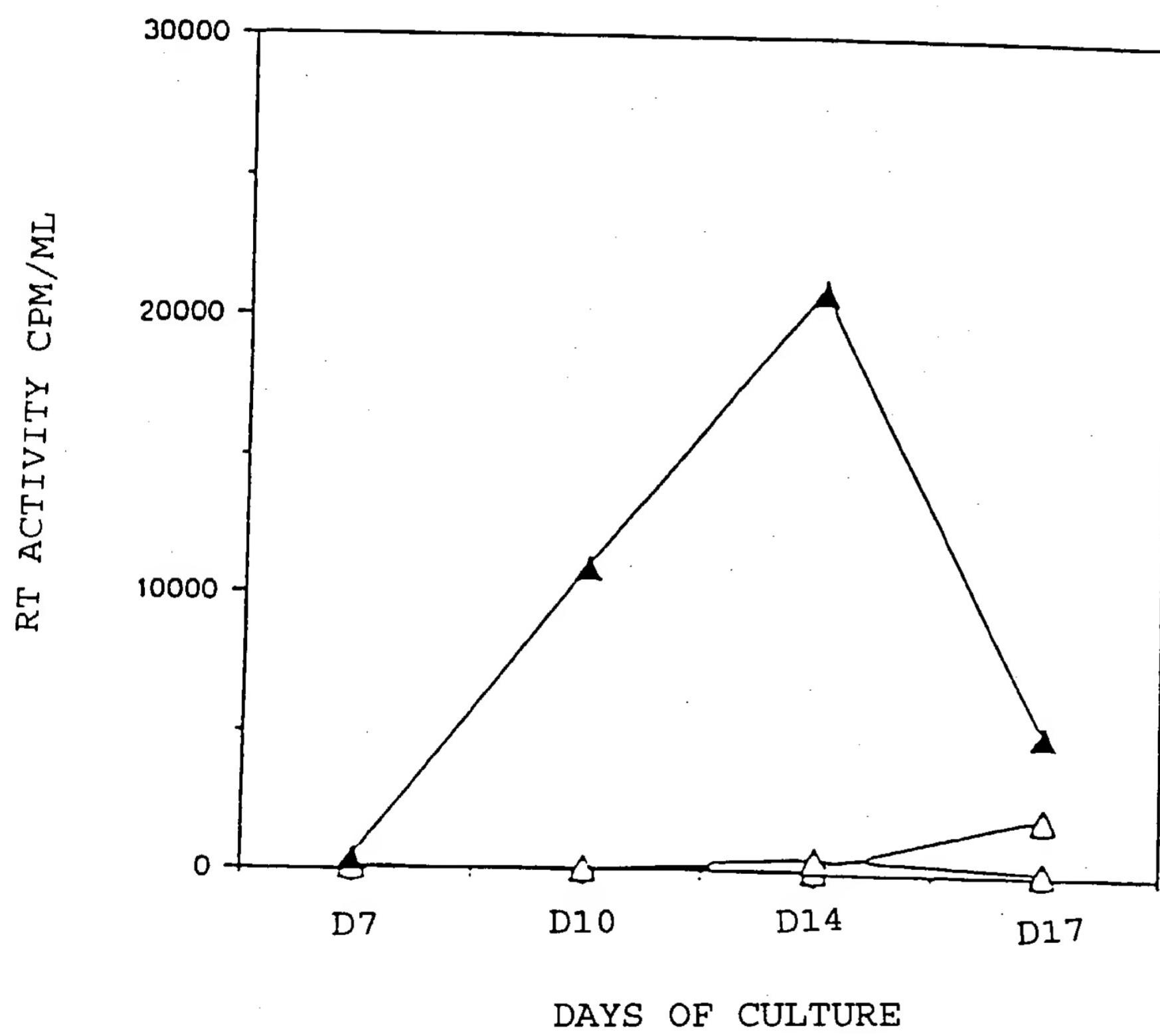


FIG. 11



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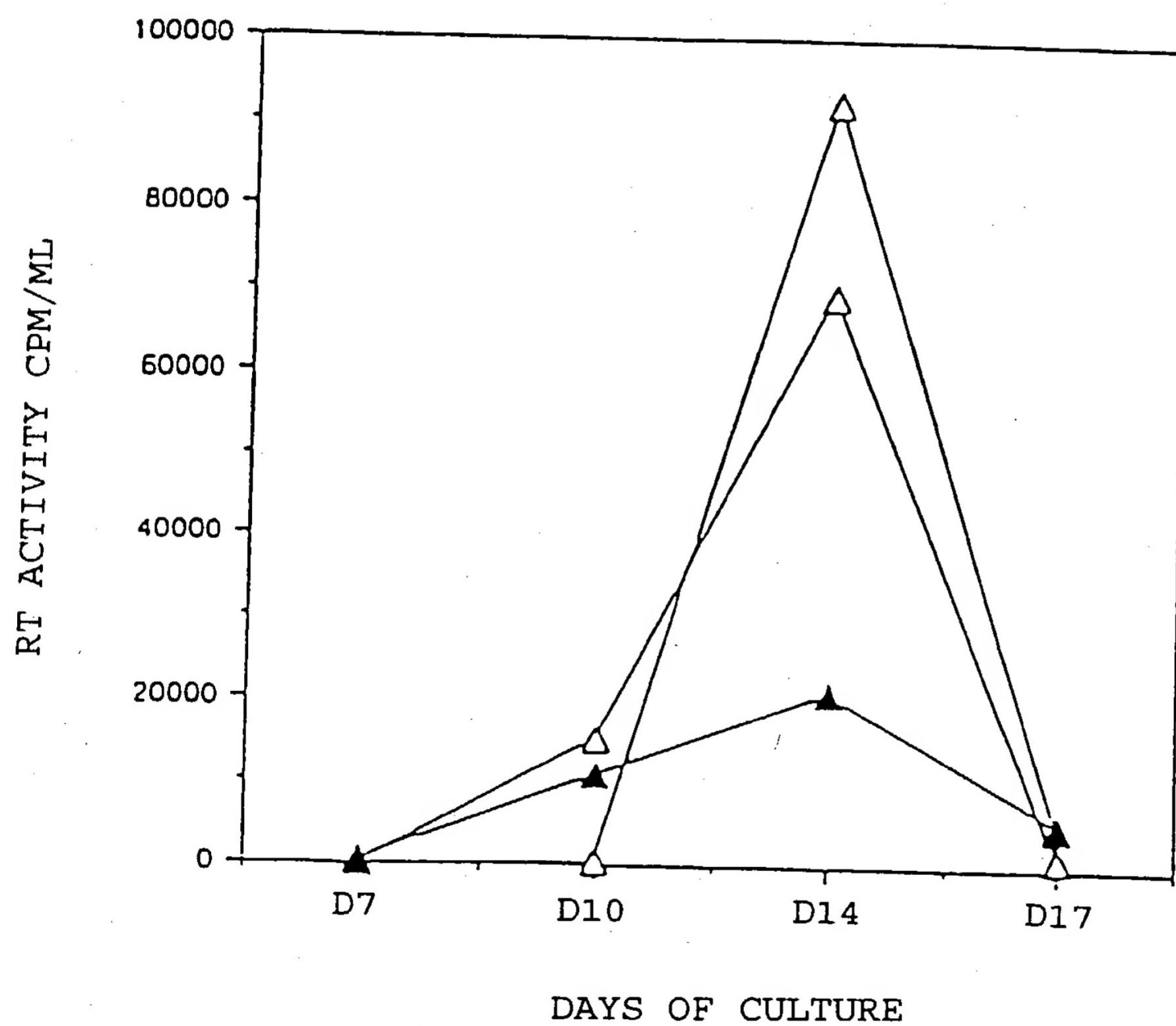


FIG. 12



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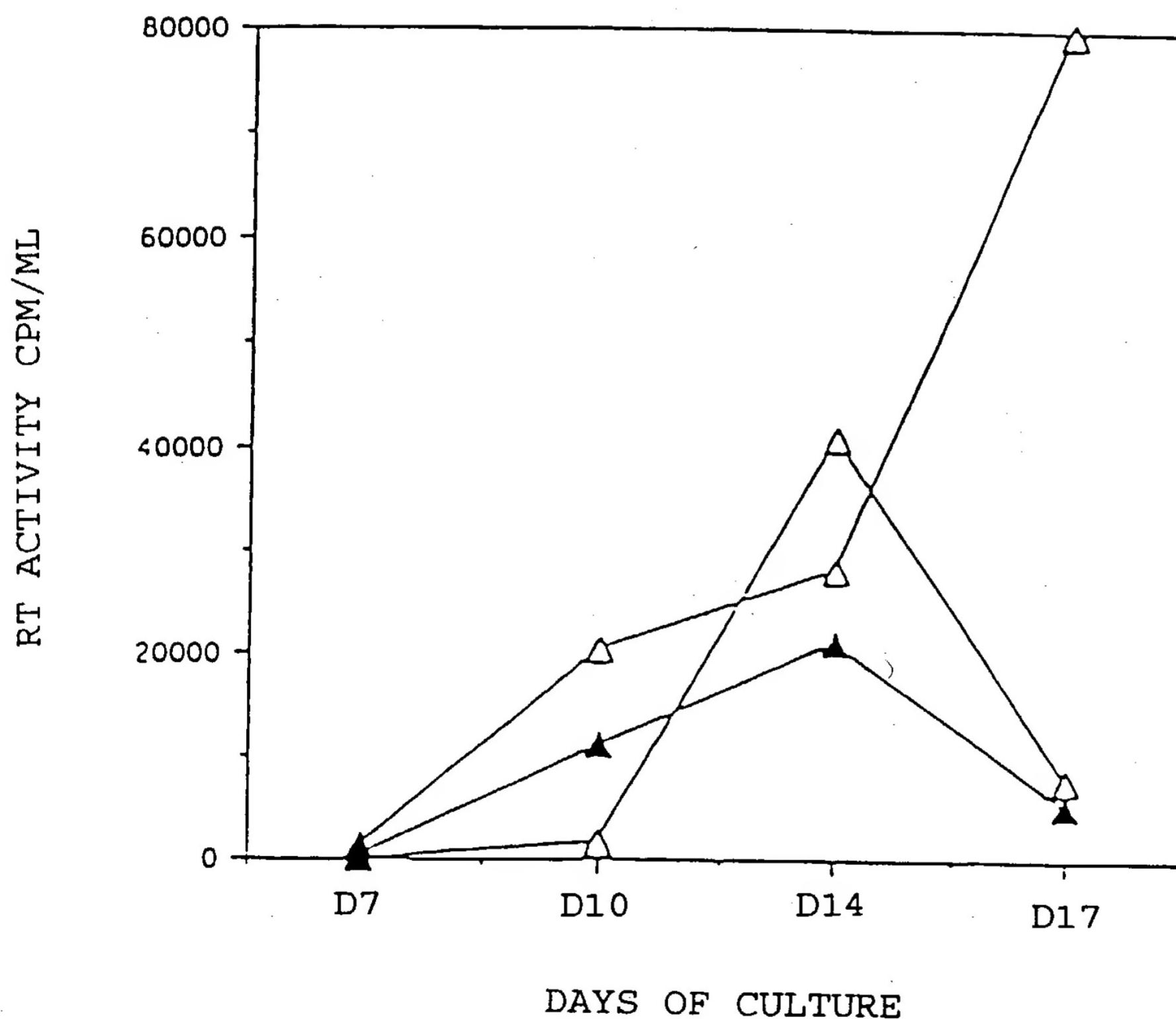


FIG. 13